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MALIGNANCY OF THE BREAST

LOUIS FRANK, M.D., F.A.C.S.,
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One would think that, in the more than fifty years which have elapsed since the suggestion that cancer of the breast was a purely local disease, the treatment would have become standardized or at least stabilized. In many respects it has, due largely to the work of Halsted and Willy Meyer in 1894.

There are many questions connected with cancer of the breast, as with cancer elsewhere, which we do not understand and which continue to invite investigation. These concern not only the course and duration of the disease locally, but also its dissemination, recurrences and their distribution, and prevention. A study of the prevention of cancer deals necessarily with a study of all so-called precancerous lesions. If such precancerous conditions exist their recognition is imperative and some effective means of handling them must be developed and accepted.

The diagnosis of breast malignancy in its very early stages should offer no great difficulty to the trained and careful clinician. On the other hand, the beginning processes that take place in the conversion of benignancy into malignancy may necessitate extensive search and intensive study by expert pathologists.

Have we a satisfactory explanation for the slow-growing scirrhous carcinoma of the breast, the life history of which extends over years, permitting the patient to make her exit from the stage of life by some disease unrelated to her new growth? Or is there a quite different process in that slow-growing scirrhus which may present glandular involvement and produce death with very little evidence of the primary disease in the breast? One would think that a scirrhus is always a scirrhus. What determines connective tissue proliferation and hyalinization in one growth and not in another of identical histologic type? Halsted said: "Scirrhous cancer represents only a part of what has existed. The struggle against cancer cells, resulting in fibrous tissue proliferation, is not always futile, and when minute foci of cancer epithelium have been destroyed, the new fibrous tissue may, in part, be absorbed also. Thus scirrhous disease may be active and metastases take place a long time before visible or palpable tumor is developed."

Does the blood of the individual contain anything that may be active in conferring immunity either to rapidity of growth or to the neoplasm itself? It would seem, from the studies of Vaughan, Murphy and others, that so long as there is an increase in large mononuclear cells, growth is held in abeyance, and with the rapid development of the tumor there is a marked increase of polynuclear lymphocytes. Have these observations any definite significance? What part would the Roentgen ray in massive dosage, which destroys lymphocytes, have on the growth? What would be the effect of smaller, stimulating doses insufficient to destroy lymphocytes? These and many other questions arise when one begins to survey the field of breast cancer with a critical eye. However, in this paper I shall concern myself with only a few points of practical rather than speculative importance.

First, the treatment of the local disease, i. e., the radical operation: Some recent experiences have impressed me with the necessity of removing the pectoral muscles, both major and minor, in every case believed susceptible of relief by operative procedure designated as radical. As just said, attention has been called to this by the failure, in some cases which I have seen secondarily, of the surgeon who did the primary operation to remove these muscles. These patients have consulted me on account of local glandular recurrences which undoubtedly must have existed for some time and which had begun in the glands highest and deepest in the axilla. The only excuse ever to have left these muscles was to prevent venous or lymphatic obstruction, and for the purpose of maintaining the nerves and vessels free of cicatricial tissue and resulting compression. That great surgical teacher, Murphy, recommended, we believe, leaving the muscles; but he did reflect them, clearing the axilla and then suturing the muscles over the axillary space. It was but a step further to cease dividing the pectoral end of these muscles, and without so dividing them, I am sure that not all glandular structures can be removed. True the cosmetic effect is better when the muscles are left, but in operating or treating malignancy all considerations of beauty and form,—or even function,—must be sacrificed to wide and complete eradication of the disease.

Halsted showed that the "elephantiasis chirurgica" following breast extirpation for carcinoma is clearly due to infection. In my own experience it has been impossible to remove all lymph-bearing structures without removing the pectoral muscles. I have not hesitated to resect the axillary vessels when I thought they were involved in carcinomatous infiltra-

tion, and in no instance has this been followed by permanent swelling or edema. In such venous resection the cephalic vein, however, must be carefully protected.

As routine in a standardized operation, I would also advocate removal of the fascia of the upper end of the rectus abdominis, as suggested by Handley, believing this may be the means of preventing hepatic metastases in some instances. With the primary growth in or extending into the lower quadrant of the breast I would consider the operation incomplete unless this had been done. This brings us to the discussion of recurrences. Many interesting theories have been advanced concerning the manner of dissemination. Recurrences in my cases show a marked number of secondary vertebral growths, this being the cause in about twenty per cent of ultimate deaths comprised in a forty per cent mortality in over two hundred cases. Five per cent of my patients had involvement of both breasts. In twenty per cent of the deaths there were bone recurrences; in three the parietal bone was the site of recurrence; in one the lower jaw and parietal bone; in one the sternum.

Only recently I saw a young woman with bilateral symmetrical neuritis of the lower extremities, who had been operated upon two and a half years ago for carcinoma of the breast. I am sure that, despite negative roentgen ray examination, this is due to cancer metastasis. I have seen the spine, the bones of the skull, the ribs, the humerus, and the femur, involved in one case.

Another patient operated upon very early in the disease, with no glandular involvement, the primary growth hardly palpable, not more than one-half inch in diameter and near the nipple, had a recurrence in the cervical vertebra nine years afterward and died within three months after the first evidence of recurrence was noted. It has become my rule to warn the family and the attendant of the significance of neuritis or "rheumatism," particularly when bilateral or symmetrical.

Deaver notes in the deaths from recurrences that 17% were skeletal and visceral. Williams, in 115 breast cancer autopsies, (17 at Guy's Hospital, 98 at Middlesex), found only two recurrences in the vertebræ. Handley, in 329 autopsies in cancer of the breast, found spinal metastases in 3.6%, and further that 99% of the bone recurrences were in the area liable to subcutaneous nodules explained by him on his theory of metastasis by permeation. My own belief is that carcinoma cells make their escape at the time of operation and find their way through the lymph stream into the subclavian vein, and are thence carried as emboli to the bones where they remain quiescent for a long time before establishing their growth. Such bone metastases as I have seen are not explained by the theory of permeation, and that the cells do find their way through the blood stream in bone metastases seems confirmed by the work of von Recklinghausen who observed that they occurred in the bones in the line of distribution of the nutrient arteries, which observation was confirmed by Bamburger and Paltauf.

The next point I wish to discuss is the removal for diagnostic purposes of a section of the neoplasm. I believe this should never be done unless with a cautery knife, and then wide of the suspicious area. One's clinical experience should enable him to recognize breast carcinoma by the gross appearance and feel; yet there are times, as stated above, when careful histologic study alone can determine the presence of malignancy. Should a section be thus removed for examination, the skin should be immediately sutured with or without packing while awaiting the report. If the latter is positive, then radical removal may be proceeded with beginning in the axillary space.

I would like to add that all breasts removed under the diagnosis of malignancy should have this diagnosis confirmed by microscopic examination. Too often have we seen lives made unhappy by fear of cancer following the removal of suspicious breasts, when these suspicions had never been confirmed by the pathologist.

This brings us to consideration of the removal of "precancerous breasts," i. e., breasts the subject of that type of disease included in the generic term of chronic mastitis, containing growths liable to undergo transition from benign to malignant. Bloodgood says that " the complete removal of the breast is a protective procedure in certain non-encapsulated lesions of the breast which may be included under the term of chronic mastitis." In this connection, I cite a case selected at random from a number of such to discuss the pathologic findings:

Mrs. R. B., aged 42, consulted me February 1, 1920, complaining of several small nodules in each breast which had never been painful, and which, she thought, had varied in size from time to time. Otherwise she had been perfectly well. Except for the fact that her mother died of cancer, the family and previous personal history was negative. There were small, shot-like bodies in the left breast, freely movable and not tender. There was a small gland in the left axilla. In the right breast there was a mass the size of a walnut, smooth, freely movable and not adherent to the skin. No glands were palpable in the right axilla. The remainder of the examination was negative.

The patient was operated upon February 2nd, the breast tissue on both sides being excised, leaving the skin and nipples intact. The tissue was examined at the time of operation and also later, the pathological report reading as follows:

"Section of the block examined at operation shows breast structure with excessive fibrous tissue and glands surrounded by a moderate number of leucocytes, chiefly lymphocytes and plasma cells. Some glands are considerably dilated and lined with a single layer of epithelium. Other glands are enlarged and atypical, with similar lining. A few have two or three layers of epithelium. Further examinations of sections from both breasts reveal conditions almost exactly alike. In each there is a large amount of connective tissue stroma with much intercellular collagen. About the breast glands there is a moderate infiltration

of lymphocytes and plasma cells. Many ducts are more or less dilated, some so much so that the lining epithelium is thin and 'stretched out.' Most of such cysts are filled with retained secretion and an occasional phagocyte. Some of the secretion is caked in round masses. In one section one duct is lined with papillary masses of columnar epithelium, a hyperplasia indicating a tendency toward epithelial tumor. Another evidence of neoplasm is the development of some of the glands into atypical structures lined with one or two layers of cubical epithelium."

This is the microscopic picture of that condition to which König has given the name "chronic cystic mastitis," and which is called by many authors "abnormal involution." There is a fibro-epithelial degeneration, whether inflammatory or neoplastic we cannot say, and this is the most frequent affection of the breast except cancer. Warren states that it comprises 15% of all breast diseases. Speese studied 180 breasts and found that 18% showed abnormal involution. Judd and Bloodgood state it is seen in 25% of cases of benign tumors.

In the pathological report just quoted it is stated that a few of the glands had two or three layers of epithelium. In chronic cystic mastitis we may find simple cysts lined with a single row of epithelial cells, and these cysts may or may not contain papillary projections. In others the cysts are lined with two or three rows of cells or may even be filled with a mass of rapidly growing epithelium. The latter are borderline cases, and to this type Bloodgood applies the term "adeno-cystic" in contradistinction to the other which he refers to as simply "cystic." This condition of marked intracystic epithelial proliferation is also referred to as Schimmelbusch's disease and as *maladie de Réclus,* and it has been stated that a large percentage of breasts in which this condition is found are, or become, malignant, a belief in which I fully concur.

By careful search, and especially of whole sections taken through the breast as advocated by Cheadle, of London, we will often find an area where the basement membrane seems to be lacking, or there is a definite invasion through this membrane, and cells of the same type as those in the cysts are found in the stroma about the glands. In such cases a diagnosis of carcinoma is made. The type of cancer is unimportant, for we believe this is determined by the amount of fibrous tissue hyperplasia and its density. In those breasts where the fibrous tissue is very dense there is little chance for invading cells to take a glandular formation, and we see the picture of carcinoma simplex or scirrhous carcinoma.

The last point I wish to discuss is treatment with Roentgen ray and radium. The greatest and most distinct advance in the treatment of carcinoma of the breast has arisen through use of the Roentgen ray and radium. I have treated a number of cases of glandular metastasis or extension with radium and the results have been marked in many.

My experience with the Roentgen ray has been mostly along the line of post-operative treatment for the prevention of recurrence. Massive dosage has been given with the high voltage current after removal of the breast by radical operation in a few cases only. Practically others for the last twelve years have been treated with the ordinary Roentgen ray machine. It has been my practice to subject these patients to three seances, the first beginning either a day or two after operation, consisting of four to six treatments during the period of a week; they then return at intervals of three to four weeks for a further series of treatments lasting over a period of a week each.

My observation during the past twelve years of such post-operative treatment leads me to believe, with Lee of the General Memorial Hospital, New York, that post-operative Roentgen ray treatment prevents recurrences, prolongs life, and has, without reservation, proved its worth. I am doubtful of the value of pre-operative radiation, though I have used it in some cases, performing radical operation within a week or ten days afterward. I must confess, however, that I have had some misgivings as to radiation before operation, fearing that the effect upon the lymphoid cells and the white blood cells might lessen the resistance of the patient to further cancer invasion.

With the Roentgen ray as a curative agent I have had absolutely no experience, but results in two cases in which massive dosage was used was of such character as to cause me to hesitate in advising it. Both of these patients died, one from lung fibrosis with changes of type very peculiar in some respects, in that there were consolidation and the physical signs of pneumonia without elevation of temperature, expectoration or anything otherwise to indicate the changes that had occurred. The second patient also had an extensive fibrosis of the lung over the area radiated with tremendous pleural changes.

While neither of these patients was autopsied, Hines has reported in the *Journal of the American Medical Association* two cases very similar in character with the pathologic findings at autopsy. In his first case there was found a decrease of alveolar size and number by proliferation of fibroblasts in the alveolar walls, some of which extended into the lumen; some alveoli showed cell desquamation and some were filled with almost solid connective tissue. This patient had had three treatments for secondary sarcoma.

I submit that any form of treatment showing such marked reaction to the underlying structures must be used with great caution and circumspection, provided those underlying structures contain vital organs. This has been further impressed upon me in the treatment of a case of carcinoma of the prostate by the same high voltage method, in which

I have seen develop about a week after the treatment a violent enteritis terminating in death.

SUMMARY

Early diagnosis with extensive radical operation, bearing in mind the avenues of dissemination, offers the best hope of permanent cure.

Post-operative "rheumatism," neuritis, etc., should be viewed as probably due to metastasis until proven to be otherwise.

Removal of a section of the tumor for diagnostic purposes should always be done with a cautery knife and all breasts removed as carcinomatous should be examined post-operatively to confirm this diagnosis.

Certain types of chronic mastitis may be definitely looked upon as precancerous in character.

The Roentgen ray used post-operatively is of definite value in the prevention of recurrences. Its preoperative use for blocking the lymphatics is of very doubtful value.

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FRANCIS BUILDING.

THE OCCURRENCE, ETIOLOGY AND PATHOGENESIS OF INTRAPERITONEAL ADHESIONS

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The subject of intraperitoneal adhesions forms a large chapter in surgical literature. Most of this study has been directed toward its surgical and therapeutic aspects. Only few data have been collected on the frequency of pathologic cohesions of abdominal viscera and the pathogenesis of the condition is not carefully investigated as a rule; while fairly accurate observations have been made on the etiologic factors producing these lesions.

In considering the occurrence of adhesions, one is interested in the total number of patients troubled with this lesion, the total number of organs involved in the various cases and the localization of the pathologic process within the abdomen. Very few studies on each of these points have been made, and one must always bear in mind the potential errors of limited observations especially when presented by a small number of observers. The data on which this phase of the study is based, however, come from necropsy as well as clinical material and for this reason are probably more accurate than if based on clinical investigation alone. The work of Nageli[1] with pneumoperitoneum demonstrates that there were adhesions in 79.8% of 148 surgical cases, while Kennedy[2] broadly asserts that adhesions will be observed in 100% of all patients who undergo operation. Haynes[3] and Morris[4] have given roughly the order of frequency in which the organs are involved. Their records are in agreement with the findings of Bryant[5] whose presentation is perhaps the most detailed of any yet published. His survey of 297 cases of all ages and both sexes gives an insight into the magnitude of the subject and raises the question of the clinical significance of adhesions. In this autopsy review there are observed adhesions in infants as well as in adults—though the characteristics of congenital or fetal adhesions are their simplicity and lack of multiple organ involvement. With the advance of age, there are not only more people affected but, in those individuals more organs are matted together with more complex numerous and dense cohesions. Sex apparently plays no part in the number of persons involved but varies the picture within a small percentage usually not more than 1%—as to the number and location of organs affected.

Of the organs involved, the transverse colon is by far the most frequently affected. The other organs in the order of frequency are the gallbladder, duodenum, peritoneum, omentum, ascending colon, hepatic flexure, appendix, liver and descending colon. The right upper quadrant is most frequently diseased in this manner in both sexes and all ages; then the right lower, left upper and left lower quadrants.

The etiological factors are numerous and have been thoroughly studied. One can say, in general, that except for congenital adhesions, any factor that will injure the endothelium will produce adhesions. Webster[6] seems to feel that prolonged anesthesia, systemic weakness, and anemia predispose to adhesion formation. More likely is it, however, that adhesions form in abundance in those individuals who have a great healing power —because, as we see in the pathogenesis of adhesions, these structures are dependent for their formation upon the same principles as is union of wound edges.

Congenital adhesions, as developed from faulty embryology, are questioned by certain authors, chief among whom stands Deaver[7]. His impression is that fetal adhesions are a result of intrauterine infections. C. H. Mayo[8], however, believes that such a lesion as the so-called Jackson's membrane is formed by a torsion of the colon in descending into place in the embryo. Others[9], [10], [11], support him in this view. It seems likely that

not only this lesion but others similar may be the result of faulty embryological development. More observations are needed before the etiology of congenital adhesions can be considered determined.

Developmental pathologic attachments are produced by mechanical and infectious factors. Ptosis is considered by Davison, Davison and and Royer[12] as one causation of fibrous bands passing over the ascending or ascending and transverse colon—although, as they explain, the ptosis is more marked after the adhesions than before. The observation of Campbell that depressions of the transverse colon are not caused by corsets, since they occur in men and children as well as in women (and for this reason he considers them due to an unusual length of that part of the bowel) gives further basis to the developmental character of this type of adhesions. In similar manner, the sigmoid may be too long and hang in folds. The mechanical element that is displayed in adhesions by tumors, benign and malignant, as a result of pressure and friction is also observed in misplacements of healthy organs. In these adhesions, as well as those observed around the gallbladder, appendix and points of stasis that result from infections, there is probably an injury to the endothelial surface.

The adhesions that attract the most attention from a clinical standpoint are those that follow surgical operations. The various factors of such procedures which have to do with adhesion formation may well be considered separately. Corbett[13] has noted from his experimental work that aseptic adhesions form in denervated areas. Attention has not been called to this except by him. While it does not enter into consideration in the pathogenesis of adhesions, it is well known that denervation of tissue leads to easy herniation and the close relation between adhesions and hernias is obvious. It is well then, in making incisions, to place them in such a manner as not to interfere with nerve supply. Also, one should limit the incision to only such size as is necessary to accomplish the purpose of the operation. There must be no trauma. Tissues should always be handled as gently and the operation performed as expeditiously as possible. The effort of Senn[14] to unite tissues by scraping their surfaces at the line of desired union, thus forming a stronger cohesion, is ample evidence of the necessity of avoiding damage to surfaces in operations. Exposure of intestines or peritoneal surfaces to air—especially dry air—is advised against on the basis of the careful work of Walthard (cited by Richardson[15]). Drying of a serous surface is sufficient injury of the endothelium to produce a cohesive reaction. The use of warm moist packs is thus desirable for hemostasis. The same effect is produced by contact of the peritoneum, either parietal or visceral, with chemicals, notably iodine, Dakin's solution, bichloride or biniodide of mercury, carbolic or salicylic acid. Iodoform and salol do not possess this quality to such a marked degree. Drains and preventives of adhesions—as oils, ointments, membranes of viable and nonviable variety—act in somewhat similar manner to chemical irritants; being foreign bodies, they stimulate the further formation of adhesions.

Blood does not apparently cause adhesions except in the presence of denuded areas of infection. There may be a tendency for a blood clot to injure the serous surface by mechanical pressure or friction,—but if such adhesions do present, it is probable that they easily break up in a natural manner and do not reform. If the outcome of such adhesions is not one of simple disappearance, it is not likely that they will cause clinical distress. On the other hand, adhesions forming from blood in the presence of raw surfaces or infection, may become unusually dense and firm and give rise to severe clinical evidence of disease.

In applying the cautery, it is well to thoroughly burn the intended area, so that there is a covering scab or eschar of necrosed tissue. The action of a slight cauterization is the same as that of a raw surface which rapidly produces union with adjacent viscera. This leads to the consideration of denuded areas. It is almost universally accepted that a denuded area will produce an adhesion. A few authors there are who assert that infection is the only causative factor in the formation of adhesions, but careful study of the pathogenesis of this condition shows their error. Thus avoidance of any denuded area, as a pedicle stump, the careful placing of stitches and ligatures, especially those not of catgut are among the most important constituents of good surgical technic. Neuhof and Wiener[16] reported the marked ability of the omentum to cover raw areas, even working its way into the small openings made by the needle in its passage through the peritoneum.

Turck's experience leads him to advise the application of heat at 48°-50° C. to the abdomen during manipulation to reduce the tendency to infection and shock and increase the vitality of the patient.

Pathogenesis: Adhesions form in a manner similar to normal healing. This process of repair of an incision, infected or clean, is identical with the regeneration which produces adhesions. In the regeneration of body tissues, the endothelium, epithelium and subcutaneous tissues take the most active part. Thus a scar is formed almost

entirely of fibrous tissue which at different stages of its formation contains a large or small number of vascular structures. From an open surface pour out serum, plasma and body cells forming an exudate. Into this exudate push growing blood vessels. These vessels bring nourishment to the young tissue cells, which soon give evidence of new connective tissue structure, of the yellow elastic and white fibrous forms. The epithelium covers over the raw surface.

Thus the pathogenesis of adhesions begins always with an injury to the endothelium of either one or both adhering surfaces. This injury may be produced by any mechanical, physical, chemical trauma or infection. Following the injury to the endothelial surface there exudes from the denuded body tissues a coagulable exudate which agglutinates, cohesing the surfaces. If this exudate is undisturbed, if the cohesions are unbroken, the next step is an organization of this exudative mass by the invasion of blood vessels. Subsequently a mature form of fibrous tissue occupies the space which finally forms a contracted scar. The endothelium, attempting to cover the raw surface is compelled to grow out away from its usual intestinal covering by this fibrous structure and passes thus from one loop of gut to another. The changes that occur in bone upon the institution of weight-bearing after fracture healing seem to occur in abdominal adhesions as a result of weight or pressure upon newly formed bands. They thicken and become possessed of a toughness which increases with age. Adhesions formed as a result of infection are very much thicker and more resistant, inasmuch as they form after such marked degenerative reactions, and the consequent regenerative functions of the body are correspondingly highly stimulated. Thus we find that adhesions vary in density with individuals probably as the rapidity and strength of healing operative wounds vary.

Will not, then, any substance that interferes with coagulation—as fibrolysin, thiosinamin, peptone, phosphorus—interfere with the normal closure of surgical incision as well as with the formation of adhesions since both are dependent upon the same principles of growth? The density of the adhesions also depends upon the size of the area adhering and the virulence of the reactive effect produced by the determining etiologic factor. With abscess formation, the adhesive structure walls in the collection of pus.

In conclusion, it may be said that peritoneal adhesions are of frequent occurrence and, except for those of congenital or developmental origin, they depend for their formation upon an injury to the endothelium, the pathogenesis of which is in every way similar to the normal process of healing.

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CATHARTICS IN THE "ACUTELY SURGICAL ABDOMEN."

In the treatment of the "acute surgical abdomen," cathartics have no place; the most which can be accomplished by their use, in any case, is to demonstrate that the condition is not serious. In every case in which the use of a cathartic is not actually dangerous to the life of the patient, it is not needed, because there will be a natural evacuation if no remedy is used. Never in any acute inflammatory condition of the abdomen use a cathartic and especially is this true in any form of obstruction, whether this be due to strangulated hernia, bands or adhesions, intussusception, kinking of intestines, diverticula, volvulus or neoplasms, for any one of these, the intestine suffers so severely as a result of the pressure from the peristaltic action caused by cathartics that the walls become permeable to the passage of septic material, and thus scatter it throughout the abdomen. There can, therefore, be no reason why peristalsis should be initiated by the use of cathartics. Even the smallest amount of cathartic may change a harmless circumscribed infection into a serious diffuse peritonitis, and in the non-obstructive cases the empty bowel is not desirable, because it is inducive to gas.—EDWARD F. BEEH in *The Journal of the Iowa State Medical Society.*

POST-RECTAL TUMORS

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We shall consider here the various neoplasms of the retro-rectal soft tissues, those with attachment to the ventral surface of the sacrum or coccyx, and others arising from the dorsal aspect of these bones.

Coplin[1] says:

In the sacrococcygeal field the common tumors of wide distribution are rare, and the rare tumors of other parts are here more frequent. Fibroma, chondroma, osteoma and lipoma are infrequent; carcinoma and sarcoma rare; papillomata of various types are probably the most common of the simpler neoplasms involving this region; angioma and endothelioma have been observed. It is not unlikely that the gliomata described have been types of teratoma in which a single element overshadowed other structures. Sebaceous cysts and hygroma, the latter probably of bursal origin, deserve little more than mention.

The important neoplasms of special interest to the practitioner because of their practical importance, and to the ontologist by reason of their histogenesis, are now conceded to be derived from developmental errors frequently arising early in the evolution of the embryo. Perfect evolution of the tissues embraced in this part of the body is beset by many narrow escapes, and the sharply drawn lines which nature must follow render many and varied deviations so easily possible that it is a wonder that disaster is not of more frequent occurrence. It is in this area that the caudal termination of the primitive streak must most accurately attain its evolution and involution, and the neurenteric canal develop and disappear; the anus complete the intestinal tube; the posterior fissure properly close; coccyx and sacrum develop; the inferior evtremities symmetrically adapt themselves to the trunk; possibly the caudal appendages of our ancestors bud and disappear; and all of these, and other processes of development, must keep uniform pace so that none may outstrip another in the relatively rapid growth of all parts involved. Added to these, in the embryo, within a few millimeters of the area under consideration, is progressing the complicated evolution of the genito-urinary organs. Inaccurate coaptation of fissural margins; delayed closure of clefts; ectopia of fragments; sequestration of cell groups; delayed disappearances of structures that normally atrophy; and inclusion of contiguous elements, are possibilities, any one of which constitutes a deviation from the normal, which, later, during intrauterine life or post-anal existence, may jeopardize the well-being of the individual.

Bland Sutton[2] says:

In the early embryo the central canal of the spinal cord and the alimentary canal are continuous around the caudal extremity of the notochord. This passage, which brings the developing cord and gut into such intimate union, is known as the neurenteric canal. When the proctodeum invaginates to form part of the cloacal chamber it meets the gut at a point some distance anterior to the point where the neurenteric canal opens into it; hence there is for some time a segment of intestine extending behind the anus and termed in consequence the 'post-anal gut.' Afterwards this post-anal section of the embryonic intestine disappears. These tumors are congenital in origin although they may not take on active development until adult life.

Tumors arising in the remnants of the post-anal gut present much confusion in their pathology and thus varying reports are received after laboratory examinations of specimens. Closed vesicles are found lined with glandular epithelium and containing glue-like fluid. Many of these tumors are composed of cysts and duct-like passages lined with cubical epithelium held together by richly cellular connective tissue. In many instances the epithelium is columnar, set upon flatter cubical cells. The cysts are filled with ropy mucus, and vary in size from a nut down to microscopical spaces; the varying cytology of these tumors may be well accounted for by extensive development which normally and anatomically grows from the wolffian bodies, and it is from these wolffian bodies with their embryonic cycles of origin, function, degeneration and quiescent persistence, that these oftenest spring. They lie in the region where, in the embryo, the neural canal differentiates itself from the intestinal canal where the wolffian body becomes the renal system, and the wolffian duct becomes the vas deferens in the male, and degenerates in the female. It is here, in the adult, that bladder, ureter, bowel and vas are contiguous.

Law[3] notes that there is much uncertainty regarding the etiology of these tumors. Middledorph[4], who first brought these tumors to surgical attention, says they arise from local disturbances of the development of misplaced tissue *anlage* of the post-anal gut, medullary canal and neurenteric canal, in conjunction with ectodermal and mesodermal inclusions. These views are further supported by Masse[5]. Borst[6] says that disturbances in the caudal region may make it possible for portions of the *vestiges coccygeus* to be transplanted to the ventral side of the sacrum, and there give rise to the tumors.

Dermoids

Dermoids are tumors composed essentially of derivatives of the ectodermal layer and are furnished with skin occurring in situations where this structure is not found under normal conditions. They may occur almost anywhere but are perhaps most common in the ovary, where there may be several.

They are frequently situated where, during embryonic life, coalescence takes place, between cutaneous surfaces. These are designated "sequestration dermoids." A rarer type arises in what are called obsolete canals, and are called "tubulo-dermoids." Tumors belonging to this genus are found only on the head, neck and trunk. The simple dermoids are cysts containing or lined with ciliated, flat or columnar epithelium. True dermoid cysts may be found forming a part of the more complex solid tumors. They have been found growing from the mucous membrane of the rectum, and may protrude from the anus by a pedicle. When originating in the upper region of this organ they may cause invagination of the bowel producing intestinal obstruction.

Clinically, a dermoid cyst is round or irregularly multilocular and on incision is found to have a tough, hard wall and to be filled with a soft, greasy mass of granular, buttery consistency, in which there are often tangles of hair. Sometimes the hair may be extremely long and abundant. It does not spring evenly from the whole wall but has its roots in a thickened patch which is constantly present in the wall of such cysts. There are sebaceous glands around the whole wall of the cyst which secrete the material filling the cyst. Some of the dermoids resemble teratoma by containing teeth, bone and muscle tissue. Degenerative changes sometimes oc-

cur in the cyst; calcification and occasionally carcinoma developing.

Treatment. If suspended by a pedicle the attachment should be transfixed at its base and securely tied, and the dermoid cut away. If deeply attached or covered with other tissues they must be enucleated.

TERATOMA OR EMBRYOMA

Teratomata differ from ordinary tumors in that they are not composed of one type but are a conglomerate mass containing representations of all three germinal layers. There is no tissue that may not be represented. They have been reported as originating in the sacral region, the brain, bladder, ovary, testicle, thorax and peritoneum.

Middledorph was the first to clearly associate these congenital tumors with the post-anal gut. Fetal rests from the obliterated bowel form the nidus for the growths. Although there are many theories as to the cause of these tumors, pathologists and embryologists are generally agreed that teratomata arise from the development of misplaced tissue *anlage* known as mono-germinal tissue implantations. Teratomata generally show evidences of all three fetal layers, as may the mixed tumors, and are believed to be due to a proliferation of the remnants of the medullary canal, neurenteric canal and hindgut in association with ectodermal and mesodermal inclusions. Schlagenhaufer[7] regards the more complex teratoma, where an entire limb, an eye, a bronchus, vertebra, rudiments of intestine or liver may be demonstrated, as an incomplete monstrosity or twin which has, with its fetal membranes, spread into the tissues of the host. It is an unsuccessful attempt to form a fetus (a so-called suppressed fetus).

These tumors are not very uncommon. When they develop on the dorsal surface of the sacrum they project outward as a distinct tumor or as an arm or leg. Gant[8] reports three such cases of caudal appendages. Practically all of these tumors are encapsulated and arise from the connective tissue or have a pedicle attachment to the sacral peritoneum. They are seldom attached to the bone. On the ventral surface of the sacrum they may be attached, by a pedicle, to the bone or may be enveloped in a capsule. Many of these tumors are demonstrable only by vaginal or rectal examination; others distend the perineal or coccygeal region even hanging down from the body as a pedunculated sacral appendage.

Ohrenstein[9] reports a peculiar case of teratoma in a woman.

At the age of 5, a long tuft of hair suddenly appeared at the anal opening, and later reached a length of about 10 cm., so that the patient was compelled, from time to time, to cut off the hair that protruded. She always had the feeling of a foreign body in the rectum. The stool during all the years had presented the form of a hollow cylinder. She had had no particular trouble except in the case of hard stools. A few hours before admission to the hospital, at the age of 26, a profuse rectal hemorrhage occurred, and, at the same time, a tumor, the size of a man's fist, appeared at the anal opening. The apex was irregularly lacerated and the color was bluish black. A tooth appeared in the lacerated opening and was removed. The tumor was attached to a pedicle, which extended from 11 to 12 cm. within the rectum. The following day laparotomy was performed; the utero-ovarian ligament was divided close to where it entered the intestines and was removed with the left tube. A degenerated portion of the right ovary was also resected. The tumor was drawn from the rectum by the pedicle, and the pedicle was excised from the rectal wall. Recovery was uneventful. The tumor was a typical teratoma with all three germ layers represented.

At times a neoplasm may rupture into the rectum, vagina or bladder. Keen[10] reports one that opened spontaneously between the sacrum and coccyx.

When situated within the pelvis and occupying the cup-shaped cavity of the sacrum, these tumors push forward and upward until they may be felt and sometimes even seen above the pubes. In this position they may be mistaken for uterine fibroid, ovarian cyst, intraligamentous cyst or anterior spina bifida with meningocele, tubal or abdominal pregnancy, pelvic abscess and hypertrophied prostate. The tumors are easily palpated by vaginal or rectal examination and clinically they cause pressure on neighboring organs.

Pearse[11] emphasizes that they thus invite attack by ventral incision and the literature shows cases that have gone on to serious destruction of tissue, also the difficulty of controlling hemorrhage, and the infection of the operative field incident to an operation that traversed the peritoneum to reach the seat of dissection and excision; yet the dorsal position for the operative case is such a common one that, unless carefully instructed, a house service is apt to present such a case prepared for ventral section. An added invitation to suprapubic attack is the error in diagnosis.

Pathology. Most of these tumors are definitely excapsulated and may be completely shelled off from the sacrum. Although they are classed as benign, local recurrences as well as metastasis have been reported.

Pringle[12] reported a case with two metastatic growths, each the size of a hen's egg. They were both in the right inguinal region; one had appeared 33 years and the other 20 years prior to the time of examination.

Parin[14] collected six cases that were malignant and these tumors should therefore be considered on the borderline of malignancy.

Clinically their recurrence resembles sarcoma. They travel along lines of blood supply. Metastasis is into muscle, fascia and fatty tissue rather than along the lymph channels. Their recurrence is along scars made for their removal.

Treatment. Through an erroneous diagnosis the patient may be submitted to an exploratory laparo-

tomy, the abdomen being opened by a median incision. The tumor is then found to be retroperitoneal and behind all the pelvic viscera. By this method of approach the operator must work in a deep cavity where the control of hemorrhage is difficult if not impossible. Attack by the peritoneal route is likewise impracticable because the rectum and ureter have been pushed down by the growth. Sacral resection is the only successful way to reach these growths but even this posterior route is too grave an operation to supplement a previous exploration.

The patient is prepared in the right latero-prone position, the hips being well raised and the thighs flexed. A Kraske incision, beginning just posterior to the anus, is carried up in the median line to the upper limit of the coccyx and then follows along the left edge of the sacrum. This incision is carried down to the bone and the wound is widened to the right and left, lifting off the gluteal muscles until the sacrum and sacro-sciatic ligament are exposed.

The third sacral nerves are to be identified and the sacrum divided below them. The central canal of the sacrum is not to be opened. The attachment of the sacro-sciatic ligament to the coccyx is severed and the lower sacrum is also freed by blunt dissection. The amputation is best done with a Gigli wire saw. The use of chisel and mallet here causes shock.

As the sacrum is lifted off the tumors are often in plain view and after all bleeding has been arrested the growth may be leisurely studied and can usually be removed without disturbing the pelvic viscera or opening the peritoneal cavity.

Lipoma of the Perirectal Structures

Lipomata occur in almost any part of the body in which there are deposits of normal fat but occur most commonly in the subcutaneous tissues of the back, neck, shoulders, and buttocks. When situated in the perineum they may be mistaken for pudendal hernia or the converse erroneous diagnosis may be made.

The tumor, when composed almost wholly of fat, is soft and lobulated.

Sometimes the fibrous septa are so pronounced as to justify the name fibrolipoma and again there may be such an excessive vascular supply as to suggest the term angiolipoma. The tumor is nearly always encapsulated and may be shelled out of its bed. When so removed it does not tend to recur. Calcification and even ossification in necrotic areas is sometimes observed.

These tumors are sometimes quite tender or even spontaneously painful and, as they sometimes reach enormous size, may be associated with mental, motor, sensory and trophic disturbances. Rankin and Scholl[18] report a man who presented a lipoma weighing 3200 gm.

Glioma

Gliomata are tumors of the neuroglia which spread into the important structures of the nervous system and cause serious pressure symptoms.

Klimpton[19] reports two cases of glioma of the buttock. Both patients were 14 weeks old. In one case the cyst extended upward in front of the spine to the first lumbar vertebra. It apparently had had some connection with the spinal canal from the side of the coccyx and the anterior surface of the sacrum. On the inner side of the sac was a large, red, soft, cellular, infiltrating mass. In the other case the tumor was adherent to the rectum for about two and one-half inches. When the pedicle was freed, except for final attachment, it was found to come from the inner surface of the coccyx, the lower end of which was removed with the tumor.

Chordoma

Chordoma are rare tumors which arise from the sacrum and other parts of the vertebral column and which show a tendency to recur locally after removal and to invade neighboring structures but do not spread by metastasis. Mueller[16] has shown that these growths are derived from remnants of the chorda dorsalis. Stewart [17] after a search of the literature found nine in the sacro-coccygeal region. Hirsch and Ingals [18] have added another. Stewart in his report mentions one sacro-coccygeal chordoma that recurred locally and produced metastasis.

The tumor may grow to the size of an apple and produce pressure on the rectum and bladder or obstruct the pelvic outlet during childbirth. By intrarectal examination the mass is smooth, firmly elastic to the touch and the rectal wall is free above it. The growth may be pedunculated or lie flat upon the sacrum or coccyx.

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EFFECT OF INSULIN ON PATIENTS AFTER ETHERIZATION AND OPERATION

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Following the report of Best, Smith and Scott* in December, 1923, that an etherized dog's blood contained 0.29 units of insulin per 100 c.c. of blood as compared with 2.93 units per 100 c.c. in a normal dog's blood, and 1.66 units in a diabetic dog's blood, it seemed worth while to study the effect of the subcutaneous administration of insulin to human beings immediately after etherization and operation.

A series of 30 consecutive general surgical cases from the Lahey clinic at the New England Deaconess Hospital was chosen for study. These cases consisted of hernioplasties and various laparotomies—chiefly cholecystectomies, appendicectomies, and hysterectomies. All cases were given deep anesthesia to complete relaxation by the open drop method of etherization, and all were etherized by the same individual (Sise). The blood sugar determinations were made just before the administration of ether, 15 minutes after the withdrawal of ether, and 6 hours later. These determinations were made on six individuals to whom insulin was not given and four to whom 10 units of insulin were given immediately after making the second blood test.

The urine in 29 cases of the series was examined for sugar, acetone, and diacetic acid, the sugar determinations being made with Benedict's test, the acetone with a modification of the Rothera sodium nitroprusside test, and the diacetic acid with ferric chloride. The samples of urine were obtained shortly before operation, and approximately 6, 12, 18, and 24 hours after. Record was kept of the vomiting and of the general post-operative condition and comfort. Another group of similar operations was selected at random from the same clinic and was used as a control with which to compare our cases in regard to vomiting and general post-operative condition.

The amount of insulin given was 10 units (U 20). As will be seen from the accompanying table it did not materially influence the blood sugar. The dose of insulin chosen was purposely small because of fear of an insulin reaction and the probability of being unable in patients recovering from etherization to detect such a reaction should it occur.

Glycosuria occurred in the specimen of urine passed six hours after the operation in two of 8 cases which did not have insulin, and in two of 21 cases that did have insulin in which urine was obtained. Post-operative acetonuria occurred in 2 of the 8 cases that did not have insulin. In one of these it occurred 6 hours after operation and lasted for 36 hours, and in the other it occurred 18 hours after operation and lasted for 6 hours. Acetonuria occurred both before and after operation in four of the 21 patients to whom insulin was given and whose urine was examined. Post-operative acetonuria occurred in 12 of the remaining 17 cases. Only 4 of these 12 showed a sufficient amount of acetone bodies to give a reaction with ferric chloride, and in none of the cases was there enough acetone bodies in the urine to make it seem probable that there would be sufficient acetone bodies in the blood to cause a marked lowering of the carbon dioxide content.

*American Journal of Physiology, 1924, 68, 161.

TABLE I.
Blood Sugars

Six cases given insulin and five cases not given insulin.

	Before operation	Immediately after operation and before insulin	6 hours after operation
10 units insulin injected after operation	0.12%	**0.17%** Immediately after operation	0.15%
No insulin	0.11%	**0.21%**	0.17%

TABLE II.
Condition after Operation

20 Cases given insulin and 30 cases not given insulin.

	Average number of emeses after operation	Average number of hours before taking solid food
10 units of insulin injected after operation	3.8	55
No insulin	3.3	43

The subcutaneous administration of insulin produced no favorable effect on the post-operative recovery as regards either vomiting or general discomfort, and the period of complete recovery from anesthesia as evidenced by the taking of solid food was not shortened. The table shows a slightly greater amount of vomiting and a longer period before the taking of solid food by the patients who had insulin. The variation of individual cases is so great that, in a group of this size, the difference noted in the vomiting is well within the limits of error, and the difference in the time of taking solid food is probably within the limits of error.

CONCLUSIONS

The post-operative administration of 10 units of insulin subcutaneously has no favorable influence on recovery from operation and etherization.

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THE RETICULO-ENDOTHELIAL SYSTEM

During the past fifteen years, there has gradually accumulated a mass of information concerning the significance of a group of cells which are diffusely scattered throughout the body and to which the name of reticulo-endothelial cells has been given. Cells of this group had previously been studied by Metchnikoff, Ranvier, Maximov and others but the credit for recognizing the essential similarity of these different cells and of grouping them under the generic category of the reticulo-endothelial system belongs to Aschoff and his coworkers. This group is so widespread in its distribution and so all-embracing in its functions that practically no problem in anatomy, hematology, pathology of metabolism, pharmacotherapy or even tumor formation can be considered without discussing the reticulo-endothelial system.

The cells of this group, while differing somewhat markedly in their morphologic appearance are all characterised by their power of storing electronegative colloidal material. Thus their ability to store carmine has been used as a means of identification of the members of the group. Among the other substances which it is in their power to store must be considered various colloidal products of metabolism such as cholesterol esters, phosphatids and the intermediate products of protein metabolism. In all conditions in which a hypercholesterolemia exists a marked storage of cholesterol is observed in the Kupfer cells of the liver, in the histiocytic cells of the spleen and certain cells of the skin which belong to the reticulo-endothelial system. Gaucher's disease must be considered as an affection of the reticulo-endothelial cells in which particularly the metabolism of proteins is disturbed. In the metabolism of iron it is the cells of the reticulo-endothelial system which store for future use the iron obtained from destroyed blood cells. It is because of this wide participation in the general processes of metabolism that these cells have been called the endothelial metabolic apparatus.

Closely allied to this function of metabolism, is the function of immune-body production and phagocytosis. It has been shown that the cells of this group have the power of producing lysins and agglutinins. The monocytosis observed in typhoid fever and subacute bacterial endocarditis, the characteristic endothelial proliferation about the tubercle and lepra bacillus are all of cells belonging to the reticulo-endothelial system. The storing of anthracotic particles in the bronchial lymph glands and the removal from the circulation are carried out by cells that show the characteristic reactions of this system. Thus to its metabolic function must be added that of immunization against bacterial invasion.

All of these cells are derived from original mesenchymal tissue. In the bone marrow, in the spleen and in the liver during embryonic life they are active in the formation of blood cells of both the red and the white variety. In the adult, this function is performed mainly by the macrocytes of the bone marrow though in severe anemias, the function may again be resumed by the earlier cells. This function of blood formation has been disputed by many but the weight of evidence would seem to be in favor of it. In fact, it is even possible that some disturbance of this function may account for the appearance of the various types of leukemias.

The reticulo-endothelial system is just as significant in the process of blood destruction as it is in the process of blood formation, and by the administration of proper blood poisons the whole picture of erythrorrhexis by these cells can be easily observed. Along with this capacity of red blood cell destruction the problem of bile production must be considered. The power of reticular cells to produce bile involves the problem of extrahepatic bile formation and would explain the occurrence of green discoloration so often seen about hematomata especially of the intracranial variety.

In the absorption of hematomata, in the scavenging of wounds preparatory to the beginning of the reparative processes in the growth of hemangiomata and the endotheliomata it is the reticulo-endothelial cells that come to the fore. A proper knowledge

of this group of cells is essential to any adequate comprehension of fundamental problems of medicine.

INSULIN IN ACIDOSIS

With the accumulation of experience and its proper evaluation, the routine use of insulin in the preoperative treatment of diabetic patients has become firmly established. The mechanism of the insulin action has been recognized as a mobilization of glycogen with the purpose of completely oxidising the products of fat metabolism. In the acidosis developing in non-diabetic patients after the administration of an anesthetic exactly the same conditions arise as are observed in the diabetic acidosis. There is a marked ketosis, an acetonuria, a lowering of the plasma CO_2, irritability, air hunger and all the classical signs to be noted in a case of typical diabetic acidosis. Whether the acidosis is due to some effect of the anesthetic upon the liver or whether the condition arises in consequence of some other mechanism is immaterial. The fact remains that the condition quite resembles the usual diabetic acidosis and has been treated by the administration of glucose even intravenously when necessary. It would seem only logical, therefore, that the remedy which has proven of such value in the treatment of diabetes might be applied to the solution of the problem of post-anesthetic acidosis. Thalheimer has been the most ardent advocate of its use in this condition. He has shown by laboratory studies that following the injection of insulin, the plasma CO_2 rises, the acetonuria disappears and all the signs and symptoms of acidosis vanish as promptly as in the case of diabetes. In contrast to this, however, Sise and Horner, whose study is published on page 250 of this issue of the JOURNAL, conclude that insulin (10 units) has no favorable influence on recovery from operation and etherization.

Progress in Surgery

Selections from Recent Literature

Gangrene Due to Calcium Chloride. WILLIAM A. CAMPBELL, JR., Colorado Springs. *Colorado Medicine*, September, 1925.

Campbell reports a case showing gangrene following injection of 10% calcium chloride solution in the median basilic vein as a routine pre-operative preparation for tonsillectomy. Patient moved slightly after about 5 cc. had been injected. Injection continued, but after about 2 cc. was injected, patient began to complain of a slight burning sensation and a feeling of fullness about the needle. Aspiration caused blood to appear in the syringe and no fullness could be seen or palpated about the needle. Injection began again, but patient complained of pain at once, so needle was withdrawn. No tumefaction about site of injection. There was some oozing of blood easily controlled by pressure. Patient stated that she felt warm during the injection and there was slight acceleration of pulse rate.

There developed induration and soreness and then skin gangrene at site of injection. As a result of this case and guinea pig experiments Campbell concludes:

1. Solutions of calcium chloride are not innocuous in the 5% and 10% strengths in which they are supplied commercially.
2. Any solution of calcium chloride above 1% may produce induration and gangrene when introduced subcutaneously, and this subcutaneous introduction may easily occur through technical difficulties during intravenous administration of the drug.
3. A solution of calcium chloride of 1% strength has been shown to produce no deleterious effects when injected subcutaneously in experimental animals.
4. In so-called therapeutic doses, calcium chloride has no toxic effect, the only reactions being a subjective sensation of warmth and a slight acceleration of the heart rate.
5. Either extreme care should be exercised in giving intravenous injections or commercial calcium chloride (5% and 10%) to guard against subcutaneous leakage or a 1% solution should be used.

Sporotrichosis. FRANK C. KNOWLES, EDWARD F. CORSON and HENRY B. DECKER, Philadelphia. *The Atlantic Medical Journal*, September, 1925.

Sporotrichosis is of world-wide distribution, having been reported in Europe, the Americas, Asia, and Oceanica.

There have been 125 cases of sporotrichosis reported in the United States, in 66 of which the causal organism was isolated; 94 of these occurred in the Middle West. Very few cases have been recorded in the Eastern United States, England, and Germany.

A woman of 40 abraded her right index finger against a stove. Within twenty-four hours, a papule, reddish and indurated, developed at the site of the abrasion. A few days later this lesion enlarged, softened, pointed, and opened spontaneously. Two weeks afterwards similar lesions developed along the forearm, and later, lesions appeared on the hand and arm. The lesions all followed the superficial lymphatic drainage of the index finger. They were incised, curetted, and drained with no apparent relief.

Cultures showed the presence of the sporothrix. She was placed on sodium iodid, gr. xv, t. i. d., which she could not tolerate. After a week, she was given syrup of ferrous iodid, ♏ xx, t. i. d., which she has taken up to the present time. The lesions were entirely healed after ten weeks' treatment.

Poor Surgical Risks: Laboratory Assistance in Preparation of Patients for Operation and in Their Postoperative Care. WILLIAM THALHIMER, Milwaukee. *The Journal of the A. M. A.*, September 12, 1925.

Thalhimer discusses some of the results obtained by laboratory investigations of several types of patients for whom the hazard of a major surgical operation is more serious than for the average patient. This discussion is of laboratory data, their significance and their indications for certain preoperative and postoperative treatment of these patients. Thalhimer pleads not only for the study of these patients with laboratory methods, but especially for the interpretation of laboratory findings by a person who is capable of interpreting them, be he a surgeon, an internist or a laboratory worker. Probably the factors which influence the postoperative course of patients more than any others are those which have to do with renal function. Although an increased blood pressure does not necessarily indicate organic renal disease, it will be found that most patients with this condition show subnormal renal function after operation. Chemical examination of the blood is most important, for evidences of retention of nonprotein nitrogenous substances (urea, creatinin, etc.) are of great significance. Furthermore, the determination of the quantitative secretion of urea is not given the attention it deserves. Many of these patients who have only a slight degree of anemia, such as would cause no concern in the average patient, should receive transfusions both before and after operation. Next in importance to these factors is the furnishing of adequate carbohydrate nourishment to the patient. This can be accomplished safe-

ly by the intravenous route. Instead of the usual physiologic sodium chlorid solution, Thalhimer gives 100 gm. of dextrose a day in the form of either a 5 or a 10 per cent. solution. Sometimes twice this amount is given. By this means, the most important energy-giving constituent of food is supplied and is delivered into the circulation, where it is carried immediately to all the cells for either use or storage. One group of patients present themselves for operation after they have been vomiting for a longer or shorter period of time. These patients are usually in extremely poor condition and have either an acidosis or an alkalosis. The presence of acetone and diacetic acid in the urine (ketonuria) usually indicates an acidosis, but these substances may be present during alkalosis. Appropriate treatment must be given. Impaired physiologic functions of patients demand as much consideration and treatment as their organic diseases. This can be accomplished by developing a physiologic point of view, and using physiologic methods of study and treatment. Finally, this will be possible only by the expenditure of intelligent energy, and when surgeons are sufficiently far sighted to secure at all times the close cooperation with them of internists, laboratory workers, interns and nurses.

Therapy of Severe Burns. (*Therapie schwerer Verbrennungen*). G. RIEHL. Vienna. *Wiener klinische Wochenschrift*, July 23, 1925.

Severe burns of the skin have always been a source of worry to the surgeon, because in cases in which more than one-fourth of the total skin area has been burned the prognosis has invariably been fatal. Two of Riehl's assistants have shown that those who suffered a burn involving the total skin area, the life-expectancy has not been greater than 7 hours. Depending on the area burned, the life expectancy has increased until in those in whom less than one-fourth has been involved it is 43 hours or over. The use of morphin or the complete water bath has led to a diminuition of pain, but has apparently also decreased the patient's chances. Similarly the hot air treatment with the purpose of creating a crust from which the toxic products of the burn would not be absorbed has been fallacious. In the author's opinion, surgical treatment, the removal of the burned areas and the exhibition of large amounts of fluids especially by hypodermatoclysis is the best procedure. In addition, he has added the performance of repeated small transfusions. By this method, patients who would certainly have died, have either been completely cured or their prognosis rendered less certainly fatal. Before undertaking the transfusion, a somewhat smaller amount of blood is withdrawn by venesection. The transfusions may be repeated as often as every day if necessary. The usual treatment of the shock, etc., is also employed.

Two Cases of Embolectomy. GUSTAF SÖDERLUND, Stockholm. *Acta Chirurgica Scandinavica*, June 30, 1925. (Vol. LIX, Fasc. III).

(1) Woman, 42, with embolus in the left popliteal artery was operated upon about 12 hours after the onset of the first symptoms. Arteriotomy with extraction of embolus and suturing of vessel wall. At the time of operation the foot was cold and insensible. The skin of the foot was grayish-white; a mottled blue discoloration of the skin halfway up the leg.

By the operation the circulation was completely restored.

(2) Woman, 46, with embolus in the left brachial artery was operated upon about five hours and a half after the onset of the first symptoms. At the time of operation the hand was cold and insensible, with mottled bluish discoloration of the skin halfway up the forearm. Arteriotomy with extraction of embolus and suturing of vessel wall, which owing to the circulation not being satisfactory at the end of some minutes, was followed by a second arteriotomy with probing of the artery and removal of coagula. About 6 hours after operation the hand was warm, of the same temperature as that of the opposite side, and the sensibility was normal, except in the little and ring fingers where some numbness persisted. When the patient was discharged about two weeks after operation she thought her hand felt normal except that there was still a certain degree of numbness in the two fingers mentioned. The radial pulse was not perceptible. About two months later the hand felt normal but was slightly weaker than the right. There was some atrophy of the thenar and interosseous muscles, and the radial pulse was still imperceptible.—The patient was able to perform her work.

Chronic Subdural Hematoma. Its Pathology, Its Relation to Pachymeningitis Hemorrhagica and Its Surgical Treatment. TRACY JACKSON PUTNAM and HARVEY CUSHING, Boston. *Archives of Surgery*, September, 1925.

Following are some of the conclusions Putnam draws from his intensive study:

An apparently insignificant trauma to the head may in certain individuals be followed, after a latent interval which varies from a few hours to months or even years, by symptoms of cortical irritation and of intracranial pressure due to a subdural hematoma. These cases are less rare than formerly supposed.

Clinically, after a period of headache, these patients show an extraordinary variability of symptoms, particularly in the intellectual sphere. They are prone to psychoses and often become irritable, indecent and unmanageable. Choked disk is apt to be present and a frontal lobe tumor suspected.

At operation or necropsy, a subdural hematoma will be found on one or both sides enclosed in a continuous membrane slightly adhering to the dura but not adherent to the arachnoid.

In certain cases in which the onset of symptoms is delayed for only a few days after trauma, it is possible that they may be due to a hematoma formed immediately but which only announces its presence when the brain becomes edematous or congested.

In other cases the occurrence of late hemorrhages seems probable and may be due to the formation of communication between the mesothelium lined spaces and blood vessels, with rupture of one or the other.

When the presence of a subdural hematoma is under suspicion, an exploratory craniodural puncture over the hemisphere will give the most reliable evidence of the presence or otherwise of the clot. This should be bilateral as the lesion is not infrequently bilateral. A lumbar puncture may show a faint xanthochromic fluid, but often the cerebrospinal fluid is negative.

If the diagnosis is verified, an osteoplastic resection with reflection of the dura and removal of the more or less organized clot as intact as possible is the procedure of choice, with subsequent painstaking hemostasis. The removal of the dura on the basis that it is a possible source of further hemorrhage is unnecessary.

Experience tends to show that there need be no fear of reformation of the clot but that cerebral edema is apt to occur in the brain released from its long pressure. It consequently may be advisable to combine the osteoplastic exploration with a subtemporal decompression.

Should edema occur, the use of hypertonic saline or the performance of lumbar puncture should perhaps be resorted to before reinvestigation of the wound, for in no case in the present series at least has the procedure been of use.

Cleft Lip and Palate: The Correction of Late Deformities Resulting from Neglect or Improper Treatment. ROBERT EMMETT FARR, Minneapolis. *Minnesota Medicine*, September, 1925.

Farr describes the technics of various procedures.

Early bony restoration is one of the prime essentials of treatment. The preliminary closure of the lip, while aiding in restoring the bones to normal position, usually fails to fulfill this function. Too often it results in a thin lip and quite obviously cannot result in bony union of the alveolar processes.

The premaxilla should never be removed and its displacement too far backward should be prevented by a narrowing of the alveolar processes in infancy.

The necssity for overcoming late defects will gradually

disappear as the realization of the above points becomes manifest.

These late defects offer the utmost difficulty and necessitate procedures like those enumerated in this paper.

As a rule, both functional and cosmetic results will depend directly upon the application of the proper treatment at the appropriate age, but even in neglected cases, or in those in whom the results have been unsatisfactory, much may be accomplished by plastic surgery.

Repair of Inoperable Soft Palate by Utilizing the Faucial Tonsils. J. EASTMAN SHEEHAN, New York. *Medical Journal and Record,* August 19, 1925.

In three otherwise inoperable cases, the use of the adjacent palatal, tonsillar and pharyngeal tissues, effected a repair of total cleft palate conditions, the result of which was to provide a soft palate that functioned with considerable efficiency. The method is still experimental.

The palatal muscles are included in the muscle flap of which the new palate is made. A goodly portion of the faucial tonsil is brought up with the muscle, to give greater bulk to the palate, and also with a view to providing some substitute for the uvula. The flaps so separated are swung up to the median line, the distal ends are joined, and the palate so formed is connected with the important muscles, especially the palatopharyngeus.

In time the palate so constructed establishes functional relations with the contiguous muscles, and once this occurs the new organ responds to the natural demand upon it as a normal constituent in the economy of the mouth and throat.

Where the tonsils have been excised, it should not be regarded as a contraindication. The muscle flap can still be brought up, but it will not make quite as good a palate. In the three cases described the tonsils were present.

The upper point of the incision is well above the superior horizontal line of the faucial tonsil. The incision is carried well toward the cheek, thence directly downwards across the tonsil, to include its upper two-thirds, then backward over the posterior pillar, to include about a quarter of an inch of the pharyngeal membrane, then up to a level with the original point of incision. The edges of the flap to be brought up are thus outlined. The muscle, membrane and tonsillar tissue within these borders is then deeply separated, by the use of a long semicurved scissors with blunt ends.

Attention must be given to the raw areas, which if left to heal of themselves would develop contractures destructive of the newly formed palate.

Previous to the operation, the ptaient is referred to a dentist, who attaches to the upper teeth, a denture so designed that it will allow free control of a movable bar, at the other end of which is a splint to carry a moulded stent.

With the heated modelling compound attached to this splint a mold is taken of the raw area to be covered. Over this mold, when it has cooled, a Thiersch graft is placed, raw surface uppermost. The graft is made large enough to overlap the back of the stent; there it is sutured or tacked into position. Then, by moving the bar, it is brought into the desired position, the graft now being in contact with the raw area.

The Thiersch graft is cut from the inner aspect of the right leg, in the nonhairy area.

The graft is held in position for from eight to ten days, after which it is removed. Nothing is allowed to enter the mouth for three days after removal of the stent.

Two or three days before the operation, the mouth is thoroughly cleansed, the teeth with ivory soap four or five times a day. Witch hazel is used as a gargle. Suction is applied daily to the faucial tonsil to remove any infected debris that has collected in the crypts.

A day before the attempted repair a duodenal feeding tube is inserted through the nostril. Nourishment cannot be given by the mouth, and this method is better than per rectum.

The defect in the hard palate remains to be dealt with.

In the three cases cited, obturators were applied.

The patient should be recommended to an expert in speech training.

The Use of Iodine in Goiter. FRANK H. LAHEY, Boston. *The Boston Medical and Surgical Journal,* September 10, 1925.

Iodine is useful in two pathological thyroid states: 1, in regions where goiter is endemic, and the iodine content of the drinking water is low, as a prophylactic measure against the development of goiter in children; 2, as a measure to prepare toxic thyroid patients for operation.

Iodine in any form in adenomatous goiter in a definite percentage of cases brings about a thyroid intoxication by stimulating hyperfunction, in the previously inactive tumor. One should determine carefully the type of thyroid tissue present before iodine is administered over any considerable period of time; in no case is it to be given in which nodules may be palpated.

The introduction by Plummer of Lugol's solution as a method of preparation for operation in exophthalmic goiter has made it possible to complete the operation of subtotal thyroidectomy in one stage upon a great majority of our patients. It has saved many of those delirious and toxic cases which previously died before any operation could be done upon them, and it has almost completely done away with post-operative thyroid reactions.

Since the employment of Lugol's solution Lahey has observed a higher percentage of myxedema following subtotal thyroidectomy than was the case before its use, a situation which he believes is entirely explained by the fact that the type of thyroid tissue remaining after thyroidectomy in patients who have had Lugol's solution is much less active than that left in patients who have not had Lugol's solution.

Endoscopy of the Abdomen; Abdominoscopy. A Preliminary Study, Including a Summary of the Literature and a Description of the Technique. OSCAR E. NADEAU and OTTO F. KAMPMEIER, Chicago. *Surgery, Gynecology and Obstetrics,* September, 1925.

Abdominoscopy represents the endoscopic method of examining the abdominal cavity, a method which is not utilized as much as it deserves. Such endoscopy, if carefully executed, is a relatively simple and safe procedure.

Originally devised and applied by Kelling, some 25 years ago, the method in its technical details has been but slightly modified. At least 25 investigators or observers have published work concerning it.

The technic as described consists in producing a preliminary pneumo-peritoneum, passing a trocar through the locally anesthetized abdominal wall, and on its withdrawal leaving in place a flexible and air-tight sheath. This cannula then permits the introduction of any type of cystoscope preferred by the observer. With the cystoscope, an excellent view may be obtained of the interior of the abdomen, particularly in the region of the stomach, liver and bile tracts, and in the pelvic region. The kinds of operative or therapeutic measures performed with the guidance of the cystoscope in the urinary bladder may also be carried out in the abdomen.

Hernia of the Linea Spigelli. (*Herniae lineae Spigelli*). DR. S. L. KOLJUBAKIN, Smolensk. *Archiv. für klinische Chirurgie,* August 1, 1925.

The author reviews the literature and reports several cases of hernia through the pararectus or semilunar lines. These herniae resemble in all respects the epigastric hernia in type. There is usually no peritoneal sac, and the hernia occurs through an opening made by an aberrant branch of the deep epigastric artery. Most frequently only a small bit of pro-peritoneal fat is

found prolapsed. Occasionally a small sac is found alongside this mass. The symptoms are those of an epigastric hernia; vague gastric disturbances, cough impulse, a tender area over the neck of the hernial orifice, and a small properitoneal lipoma. The treatment consists in ligating and resecting the lipoma and closing the hole in the aponeurosis.

Further Observations on the Effect of Duodenobiliary Drainage on the Visualized Gall Bladder. Daniel N. Silverman and Leon J. Menville, New Orleans. *Surgery, Gynecology and Obstetrics*, September, 1925.

The duodenobiliary drainages with repeated injections of magnesium sulphate solution have produced decided reduction in the size of the gall-bladder shadow, visualized by the intravenous injection of the sodium salt of tetrabromphenalphthalein.

The gall bladder is more completely drained by repeated stimulations of the duodenal mucosa with magnesium sulphate solution.

The Relationship Between Diseases of the Biliary Tract and Diabetes Mellitus. I. A. Bigger and H. B. Mulholland, University, Va. *Virginia Medical Monthly*, August, 1925.

There seems to be a definite causal relationship between diseases of the biliary tract and diabetes mellitus. Removal of a focus of infection in the biliary tract will at least temporarily relieve certain cases of diabetes. This is another indication for early operation in gall-bladder disease in non-diabetics. Diabetes associated with gall-bladder disease should be considered an added indication for operation, but only when the patient has been properly prepared.

Surgery of the Spleen. Arthur Dean Bevan, Chicago. *The Surgical Clinics of North America*, August, 1925.

Surgery of the spleen can be divided into two quite definite groups, one in which a very considerable experience has demonstrated that splenectomy is of service, including ruptured spleen, misplaced spleen, splenic anemia, and hemolytic jaundice; the other, in which experience has demonstrated that splenectomy is not worth while and should be discontinued, there is leukemia and pernicious anemia. Bevan urges the importance of early operation in splenic anemia. So many of these cases are seen early with not very marked symptoms and at a time when splenectomy could be done with comparatively little risk and with a great deal of assurance of curing the patient. These very cases if allowed to go on without the benefit of operation, almost invariably develop into outspoken cases of Banti's disease and perisplenitis with involvement of the liver, ascites, etc.

Sequelae of Uterine Curettage during the Early Months of Pregnancy. (*Folgen der Ausschabung des Uterus in den ersten Monaten der Schwangerschaft*). G. Th. Zomakion, Ekaterinoslaw. *Zentralblatt für Gynäkologie*, August 1, 1925.

Zomakion calls attention to the fact that curettage performed even during the early months of pregnancy may have serious consequences quite apart from the gross danger of perforation and infection. Thus he observes that many of the patients treated in this manner have become sterile. Others have had ectopic pregnancies and still others have suffered from habitual abortion and various disturbances of the menstrual cycle. These sequelae may be explained as a result either of an atresia of the body of the uterus due to scar formation or as a result of injury to the uterine mucosa. Some significance is also to be attributed to the loss of the endocrine function of the uterine mucosa. This may lead to a condition of hypo-ovarism and as a result to the ectopic pregnancy. Curettage must therefore be undertaken only for certain definite and unavoidable reasons. It is particularly during the first pregnancy that this procedure is contraindicated because of the above serious consequences to the genital tract of the woman.

Pyuria in Prostatics. (*La pyurie chez les prostatiques*). H. Blanc, Paris. *Journal de Urologie*, Vol. 19, No. 6, 1925.

Pyuria in patients who have not been previously catheterized because of their prostatic enlargement should always be an indication for extensive search for the primary focus of infection. In most cases, a vesical calculus, a pyelitis or a tuberculous kidney will be found to be the cause of the pyuria. In cases that have been catheterized before the time of the examination, if the search is diligently carried out despite the apparent relationship of the catheterization to the development of the pyuria it will frequently result in the discovery of an unsuspected cause of the pyuria as mentioned above. All cases of prostatic enlargement and all cases of pyuria should not only be cystoscoped but should be submitted to roentgenography and pyelography as well. A number of interesting cases illustrating the points brought out are presented in the body of the article.

Clinical and Surgical Aspects of Renal Neoplasms. Abraham Hyman, New York. *Surgery, Gynecology and Obstetrics*, September, 1925.

In conclusion Hyman calls attention to the extreme malignancy of kidney tumors, the difficulty of early diagnosis, the disproportion between early symptomatology and pathological findings, and the importance of pyelographic data. Whereas early diagnosis, based on classical symptoms does not necessarily indicate a favorable prognosis, extension into the vein does not render the prognosis hopeless. The ultimate mortality ranges between 65 and 75 per cent, and the only way to effect a reduction of this high rate at present would be to use the cystoscope and make pyelograms, not alone in every case of hematuria, but in every case in which the patient complains of lumbar pain for which no definite cause can be found, and to examine more carefully patients complaining of intractable sciatica and lumbago.

Relationship of the Varicose Complex to the Motor Apparatus, Especially Flat Foot. (*Beziehungen des varikösen Komplexes zum Bewegungsapparat, besonders zum Plattfuss*). G. Nobl and F. Remenovsky. Vienna. *Wiener klinische Wochenschrift*, August 27, 1925.

The authors call attention to the fact that flat foot is a frequent concomitant of varicose veins of the leg. They do not believe that the first condition is due to the latter but rather that both are evidences of the same underlying constitutional defect. They have observed the occurrence of club foot probably as a result of a sort of dermatosclerosis. They have also observed and call attention for the first time to the frequent occurrence of a periostitis and bone atrophy with the varicose veins. The periostitis resembles very closely the type seen in well authenticated cases of syphilis.

Etiology and Pathogenesis of Perthes' Disease. (*Zur (Atiologie und Pathogenese der Pertheschen Krankheit*). G. Buttner, Danzig. *Archiv. für klinische Chirurgie*, August 14, 1925.

The author reports a case of bilateral Perthes disease in a child of 11. Because of the presence of numerous other deformities such as congenital pes cavus, multiple flail joints, scaphoid scapulae, tripartite patella, etc., and because of the presence of other anomalies and stigmata of degeneration in the mother, comes to the conclusion that in this case at least, the significance of trauma, inflammation, endocrine disturbances and rachitis are to be disregarded. All of these variations as well as the appearance of the bilateral Perthes' disease are rather to be looked upon as evidence of a general constitutional disturbance.

Fracture of the Greater Tuberosity of the Humerus with Displacement. Report of Two Operated Cases with Author's Technic of Shoulder Incision. Golder Lewis McWhorter, Chicago. *The Surgical Clinics of North America*, August, 1925.

McWhorter describes a method of approach in operating upon a fracture of the greater tuberosity of the humerus, designed to avoid the possibility of circumflex nerve injury

and the limited exposure of the simple deltoid splitting approach, on the one hand, and the bone dividing methods of Kocher and of Jones, on the other hand. He makes an incision along and just below the lower border of the spine of the scapula, and divides the tendinous origin of the deltoid here, then retracts the muscle downward. This gives a good exposure. He reports two operations for ununited fracture of the tuberosity, one under local anesthesia. In both he removed the fragment, sewing the attached tendons to the fibrous capsule in one case, and to the bone in the other case.

Book Reviews

Gynecologic Urology. By LYNN LYLE FULKERSON, A.B., M.D., F.A.C.S., Assistant Professor of Gynecology, New York Post Graduate Medical School; Instructor in Obstetrics and Gynecology, Cornell University Medical School; Surgeon Cornell University Medical School Clinic; Associate Gynecologist Lutheran Hospital of Manhattan; etc, etc. Octavo; 247 pages; 166 illustrations. Philadelphia: P. BLAKISTON'S SON & COMPANY, 1925.

Fulkerson appears to feel that gynecology has been slighted in respect of works devoted to its urological aspects. It is true that this volume offers no unusual information, nor is the author's championing of the cause very formidable, still the book is of some interest in that it presents a rapid review of the subject. It appears to be primarily intended for those who run and read. In his preface, the author claims for his work the purpose of discussing cystoscopy and the diagnosis and treatment of the commoner diseases of the urological tract. The discussion of the cystoscopic aspects of the subjects is much too abridged to entitle it to any such claim, while the treatment of the diseases of the urological tract is so cursory as to warrant merely the respect of a rather good compend. Thus the entire subject of tuberculosis of the urinary system gets only two pages, and the discussion of the technique of the various operations on the whole urinary tract is disposed of in a scant fifty well padded pages. It is not a bad little book, but it is by no means of sufficient significance to represent gynecologic urology presuming that the more complete works on urology did not discuss the problems here presented.

Die Chirurgie. Eine zusammenfassende Darstellung der allgemeine und speziellen Chirurgie. Herausgegeben von PROF. DR. M. KIRSCHNER und PROF. DR. O. NORDMANN. *Lieferung* 4. **Die allegemeine Lehre von den Verletzungen und den Wunden.** Von PROF. DR. FR. LOTSCH, Magdeburg. **Die Lehre von den Ersatzgliedern.** Von. REG.-MED.-RAT. DR. M. BOHM, Berlin. Octavo; 240 Seiten; 102 Abbildungen. Berlin und Wien: URBAN UND SCHWARZENBERG, 1925.

In the fourth section of the general system of surgery, the various types and treatment of injuries and wounds are discussed. This part of the work, by Lotsch of Magdeburg, constitutes an excellent though brief exposition of traumatic surgery. The various types of amputations are especially well treated and there is appended an excellent description of the principles and technique of kineplastic amputations. In the second part of the work, Böhm of Berlin treats in great detail of the various sorts of artificial limbs or parts of limbs which may be applied to the different types of amputation stumps. The whole section is profusely illustrated.

Praktikum der Chirurgie. Von PROF. DR. O. NORDMANN, dirigierender Arzt am Auguste-Viktoria-Krankenhaus Berlin-Schoneberg. *Dritte Auflage.* Grosser Oktavformat; 796 Seiten; 511 Abbildungen. Berlin: URBAN AND SCHWARZENBERG, 1925.

Apart from some slight changes, the third edition of this volume differs but little from the earlier ones. The author has made no attempt to cover the whole of the field of surgery. The general impression one gets is that he has rather attempted to give fatherly advice to the younger surgeon. Having appeared originally as short clinical discussions in a periodical journal, the different chapters have the character of intimate chats between a chief and his assistants. The result is a work of extreme interest written in an easy, discursive manner and treating of the problems that occur daily in the life of the surgeon. From his long experience as surgical director of a large hospital in Berlin, these chats are full of excellent advice of an essentially practical nature. The work is profusely illustrated with excellent photographs and roentgenograms.

Chirurgische Operationslehre für Studierende und Ärzte. Von PROF. DR. FRIEDRICH PELS LEUSDEN, ord. Prof. der Chirurgie und Direktor der chirurgischen Universitätsklinik und Poliklinik zu Greifswald, Geh. Med.-Rat. *Vierte Auflage.* Octavo; 832 Seiten; 771 Abbildungen. Berlin and Wien: URBAN & SCHWARZENBERG, 1925.

The fourth edition of Pels Leusden's volume differs but slightly from the earlier editions. It is something more than an elementary text-book of operative surgery in that practically all of the commoner operations are described with small introductory chapters on the anatomy of the part involved, and it is something less than an operative surgery in that it is not complete nor sufficiently detailed in its descriptions. Nevertheless, it is an excellent presentation of the more usual types of operative procedures, well illustrated and lucidly written. The work is divided topographically and the different operations on the various organ systems considered separately without any attempt at a discussion of the clinical picture for which the operation is indicated.

Lehrbuch der Physiologie. Im Vorlesungen von EMIL ABDERHALDEN, a. o. Professor und Direktor der Physiologishen Institutes der Universität Halle. *Erste Teil.* 8vo; 454 Seiten; 92 Abbildungen. Berlin: URBAN UND SCHWARZENBERG, 1925.

This, the first volume of a large work from the pen of the distinguished physiologist, consists of six lectures on: 1. functions of the digestive apparatus, including the liver and pancreas; 2. the functions of the spleen; 3. the organs of internal secretion; 4. functions of the genital apparatus; 5. inheritance; 6. the function of the skin and its appendages.

If the book served no other purpose than to afford a didactic presentation of the above subjects from the strictly physiological viewpoint, it would serve its purpose admirably, for it is an excellent summary of our knowledge from the standpoint of a keenly critical mind. But it is more than this. Abderhalden aims always to impress the clinical bearing of his facts, and his knowledge of clinical medicine is of no mean order.

It is also interesting to see that there is less chauvinism displayed in this volume than in most works of Continental origin. The author is well acquainted with foreign literature and refers to American and English observers repeatedly.

Diabetes: Its Treatment by Insulin and Diet. A Handbook for the Patient. By ORLANDO H. PETTY, A.M., M.D., F.A.C.P., Professor of Diseases of Metabolism, Graduate School of Medicine, University of Pennsylvania; etc., and WILLIAM H. STONER, A.M., M.D., F.A.C.P., Associate Professor of Biochemistry, Graduate School of Medicine, University of Pennsylvania; etc. Duodecimo; 133 pages; illustrated. Philadelphia: F. A. DAVIS COMPANY, 1925.

This volume, appearing in its second edition, is intended primarily as a handbook for the use of the diabetic patient. The chapters on the calculation of the diet are sufficiently clearly written so that the ordinary patient can with a little effort work out a tolerance diet. A small chapter on the value and use of insulin explains the status of this adjuvant in the treatment of diabetes. A number of simple recipes are appended.

SCOPOLAMIN-MORPHIN SEMINARCOSIS: ITS USE IN THE FOURTH THOUSAND DELIVERIES IN BARNES HOSPITAL*

O. H. SCHWARZ, M.D. AND O. S. KREBS, M.D.,
ST. LOUIS, MO.

Scopolamin in combination with morphin or some other opium alkaloid is used for the induction of that particular state of subconsciousness in the parturient woman in which she feels the pains of childbirth in a limited degree, but in which her memory retains no record of anything that has occurred while this subconscious state lasts. This combination of partial analgesia and complete amnesia constitutes the so-called Dämmerschlaf of Gauss.

The perusal of the original publication of Gauss, in 1906, demonstrates the fact that in his initial series of 500 cases he had encountered and carefully recorded most of the difficulties and most of the objectionable features of which many who took up this method of relieving the pain of child-bearing complained, and he had overcome and avoided most of these difficulties in his later series of cases. This is particularly true of the administration of morphin, which Gauss held responsible for delayed respiration in some of the Dämmerschlaf babies, which he restricted to 1/6 of a grain to be given once with the initial dose of scopolamin.

PRELIMINARY INVESTIGATIONS

The investigation and employment of Gauss' method was taken up by Dr. Henry Schwarz and his associates in January 1915, approximately ten years ago. It was at this time that the Washington University Medical School occupied their new buildings and the Barnes Hospital was opened, where adequate quarters for the development of this method were available. The newspaper and magazine propaganda and controversies for and against scopolamin-morphin seminarcosis were at their height. It seemed a public duty for institutions such as ours to make a thorough investigation of a question in which the women of America were so intensely and so vitally interested.

Before taking up this method, one of us, at the suggestion of Dr. Henry Schwarz, conducted a series of experiments in the Department of Pharmacology under the personal supervision of Professor Dennis E. Jackson. The points thus ascertained may be summarized as follows: Scopolamin in doses considerably larger than those used in seminarcosis has no material effect on the blood pressure or respiration. The well known paralyzing effect of scopolamin on the peripheral nerve endings seems to have no serious by effect in seminarcosis. It is usually manifested in the parched condition of the mouth and throat of which the patient complains. When the dose of scopolamin exceeds the amount desirable for the purpose of amnesia it causes complete mydriasis, which is a warning signal to stop further injections of scopolamin.

In animal experiments we can illustrate this paralyzing action of the peripheral nerve endings by its action on the vagi in the bronchioles and by its action on the inhibitory terminals of the heart, and by its action on the terminals of the 3rd nerve in the iris. Morphin, narcophin, and other opium alkaloids have a decided ill-effect on respiration. This effect is two-fold: In the *first* place the respiratory center is depressed and in the *second* place these alkaloids act directly on the muscle fibres of the bronchioles, causing broncho-constriction. We were able to show that the influence on respiration of narcophin is considerably less than that of morphin and narcotin.

These experiments seemed to prove that the use of scopolamin for induction of seminarcosis harmless, but that the use of opium alkaloids is likely to interfere with the prompt establishment of respiration in the newborn child. They also show that narcophin is less harmful than morphin. The advantage of narcophin over morphin is not so great as it may appear at first sight. While morphin undoubtedly has the more harmful influence on fetal respiration, narcophin is administered in doses three times as large and thus the advantage in great measure is lost. We used narcophin in ½ grain doses and now are using morphin in 1/6 grain doses.

SEMINARCOSIS—THE PLAN OF PROCEDURE

We use seminarcosis chiefly as a first stage measur,e but its effect in most instances lasts well into the second stage up to the time when the presenting part becomes visible, when one of the common general anesthetics is employed. Our method and plan of procedure has been fully described in our previous publications, and usually consists of two injections of 1/133 grs. of scopolamin repeated in forty-five minutes, the first injection being combined with 1/6 gr. of morphin. The injections are given subcutaneously. This procedure is very important, as it is not desirable to get the scopolamin to act too quickly. Subsequent injections are given, 1/266 gr., at intervals, as indicated by the course of labor and condition of the patient.

In the primiparae the procedure is usually started when there is about two finger breadths dilatation and the patient is definitely complaining of pain. In the multiparae it may be started as soon as active labor begins and the patient complaining of pain. It can be used in the multipara with advantage in cases where it is obvious that labor will not termi-

*Read during the Third Annual Meeting of the Southern Association of Anesthetists with the Southern Medical Association, St. Charles Hotel, New Orleans, November 24-26, 1925. From the Department of Obstetrics, Washington University, School of Medicine.

nate within three hours. When a multipara enters the hospital in active labor and it is apparent that her labor is to be terminated comparatively soon, we prefer to use nitrous oxid, and we presume that ethylene would especially be applicable for such cases, although we have had no experience with its use.

Special Indications and Results

Up to the present time we have used scopolamin-morphin seminarcosis, in 2,052 cases. In this paper we are preparing to report our experience with scopolamin-morphin seminarcosis in the fourth thousand deliveries at Barnes Hospital. We may say here that after the method was employed in the first 150 to 200 cases it was felt that it was a procedure without appreciable danger to mother or child, and that it had no marked affect on the prolongation of labor. In the previous papers we have demonstrated the fact that it had a definite tendency to shorten the first stage and slightly lengthen the second stage. After we had derived a considerable experience from these cases, we felt that it had its greatest usefulness in cases where labor was likely to be prolonged, particularly in elderly primiparae and cases of moderately contracted pelvis. We did not, at any time, expect to show any brilliant statistical figures to point out the advantages of the method, but felt it was particularly indicated under such special circumstances. This is especially apparent when studying our figures for our second and third thousand cases. One can readily see what effect the averages of the colored patients have on the series as a whole. The fetal mortality in these patients is unusually high. This is due to the fact that we have only from six to ten colored beds available, which are used for a great many abnormal cases.

At the suggestion of one of us, about one-and-a-half years ago, we employed the method in the ward service only in such cases in which no abnormality presented itself at the beginning of labor. This method excluded all cases in which the fetus was known to be dead and cases of moderately contracted pelvis where we could expect a prolonged labor as well as an abnormal mechanism. These cases were not allowed to suffer, but were given nitrous oxid, as they desired it, each delivery room being equipped with a McKesson Junior special apparatus on a permanent stand. This instrument has been very satisfactory in the administration of nitrous oxid, which I believe is due chiefly to its simplicity. Therefore, in comparing the results which had been obtained in the second and third thousand cases with the fourth thousand, a marked improvement in fetal mortality figures is shown in the cases taking scopolamin-morphin. This is further shown where the ward cases which received scopolamin are compared with the private cases in the same series.

When administering seminarcosis to private patients there was no discrimination made as regards the type of case in which the method was employed and the difference in the figures, accordingly, is very much in favor of the ward cases. This is all the more remarkable when we consider that the ward cases, provided they present no abnormalities, are handled by the intern staff and residents exclusively, most of whom are getting their first experience in obstetrics.

Disadvantages.

In our previous papers we have stated that there are no disadvantages of the method either to mother or child, although the mother in some instances is somewhat restless during the pain and occasionally somewhat excitable. However, we know of no method, which by such a simple procedure as two or three hypodermic injections can result in such complete amnesia over a period of such considerable time, that enables at least 80 to 85 per cent of these cases to go through labor without its recollection. Fetal asphyxia is not increased, although an occasional child is born in a state of oligopnea, from which they usually promptly recover on the slightest stimulation.

The disadvantages of the method are chiefly from the standpoint of the attendants. Someone must be constantly with the patient, particularly the one who is supervising the injections. We may say that much of our success with the method has been due to the untiring efforts of our house officers during this period of ten years. They have seen to it that the patients they handled suffered no unnecessary pain during their labor by the careful supervision of this method. The other disadvantage is the not infrequent restlessness and occasional excitability of the patient. This is, however, by no means striking. It has no effect on the patient herself but at times is quite taxing to the attendant. If this restlessness and excitability which we occasionally see, and to which Dr. Henry Schwarz referred in our second publication on the subject, can be eliminated, the method could soon be pronounced ideal.

Synergistic Analgesia.

Dr. E. Lee Dorsett of our Department, during the last two years, has used magnesium sulphate to combat the convulsions of the eclamptic woman along with other measures of so-called conservative treatment. We have followed his initiative by adopting its use similarly in our cases of this kind at Barnes Hospital. This work, as well as the recent work of Gwathmey, which describes for labor a synergistic method, namely the use of colonic instillations of ether, with hypodermic injections of magnesium sulphate and morphin, and also the more recent publi-

cation of Adams in which morphin and magnesium sulphate were used, suggested to us that the use of magnesium sulphate with scopolamin would perhaps be a far better combination that those that have been previously suggested. We feel that the magnesium sulphate might have a rather marked effect upon the restlessness which occurs in these patients from time to time. We also feel that the dose to be efficacious should be considerably greater than those recommended by Gwathmey and Adams.

During the past two months Dr. Paddock, an instructor in the Department of Obstetrics, has conducted a series of cases numbering about 20 at the present time, in which he has been attempting to establish a dosage of magnesium sulphate along with scopolamin-morphin. In this rather early state of investigation two facts are evident—that the restlessness has been decreased and that one can get along with an appreciably less amount of scopolamin than heretofore. Dr. Paddock will report on this method as soon as he has collected sufficient material to announce either any definite advantages or obvious disadvantages. We may say at the present time that this combination will probably make more effective an already well worth-while procedure.

Other Methods.

Gauss, in his original article, pointed out that civilization and scientific medicine have for a long time been striving to do away with the pains of childbirth. He enumerates in his article the various procedures which had been suggested up to that time. He points out their advantages, disadvantages and limitations. Since that time many newer procedures have been suggested, so that the methods for allaying pain during childbirth are fast becoming legion. Since Gauss's article the use of nitrous oxid has been developed in this country and has become particularly popular. The use of ethylene bids fair to replace nitrous oxid. Sacral anesthesia has been recommended and more recently the synergistic method of Gwathmey and its modifications.

In the recent French literature the use of somnifen, a derivative of the ureid group, which is a combination of diethylbarbiturate of diethylamin and the isopropylallyl-barbiturate of diethylamin is described. After the introductory work of Redonnet, Wiki and others, this preparation had its introduction to obstetrics by Cleisz and Perlis in France. The method is briefly, an injection intravenously of 6 to 9 c.c. of this substance, depending upon the weight of the patient, taking about three minutes for its injection. This procedure insures complete anesthesia for from three to five hours. They state that sleep once obtained, there is no appreciable change in color, respiration or pulse. Labor takes place normally but more rapidly than usual. Expulsion takes place spontaneously, the woman assisting excellently, although she is semiconscious. If the patient should regain consciousness at the moment of expulsion a small inhalation of chloroform will restore anesthesia. No effect has been noted on fetal heart beat, the infants breathing normally and immediately. There are no signs of asphyxia or sleep in the newborn. The method is begun when there is dilatation in the primiparae the size of a two-franc piece, but gives the best results if it can be delayed to the time there is dilatation the size of a five-franc piece. From their descriptions one would be lead to believe that at last an ideal method has been found. At least their work warrants attention. We are preparing to procure this preparation and hope to study its action experimentally and possibly employ it clinically, that we may for ourselves determine its value.

All these methods, have, undoubtedly, their definite advantages and their different indications for application. They are perhaps most successfully used by those enthusiasts who have recommended them, which is almost true for any procedure.

We, however, have no sympathy for the medical man who states that the value of most of these procedures is rather doubtful, and that they are time consuming, and somewhat unnecessary. That certainly is not the attitude of a progressive, scientific medical man. We feel, on the contrary, that the use of any of these methods, provided they are equally safe for mother and child, must have distinct advantages, and only by the careful consideration and study of such methods and their modifications or combinations, which must result, can there develop a method which from every standpoint shall be pronounced ideal.

We are adding our tables for the fourth thousand cases which have been compiled similarly to the second and third thousand cases, which includes only those cases of labor in which the fetus weighed over 2500 gms. We are also including a list of the fetal deaths, with circumstances under which they occurred, many with autopsy reports. We also included, in a special group, the fetal deaths in the series of cases in which the fetus weighed between 1500 and 2500 grams. In Table 2 we have compiled the averages for the second, third and fourth thousand deliveries collectively.

Autopsies.

Private Pavilion. Primiparae. Without Scopolamin-Morphin.

No. 5062. Stillborn. Full term. Wt. 3790 gms. Pregnancy normal. Pelvis generally contracted. Position S. D. A. Labor 15 2-3 hrs. Breech extraction.

Autopsy: Spina Bifida. Hydrocephalus. Fetal atelectasis.

Private Pavilion. Multiparae. Without Scopolamin-Morphin.

No. 4779. Stillborn. Full term. 2910 gms. Toxemia of pregnancy. Toxic psychosis. Acidosis. Albuminuria Labor 3 1-2 hrs. *No autopsy.*

No. 5694. Died 12 hrs. after birth. Gestation 36 weeks. Pregnancy normal. Position R. O. P. Labor 10 35-60 hrs Delivery by low forceps, double application.

Autopsy: Multiple tears of falx cerebri and tentorium with extensive intracranial hemorrhage; hemorrhage into upper

poles of both kidneys; hemorrhage into adrenals, medula and intralobular septa of lungs; atelectasis.

No. 5433. Died few minutes after birth. Full term. Wt. 3150 gms. Pregnancy normal. Pelvis normal. Labor 7 25-60 hrs. Spontaneous respiration and cry at birth. Child lived a few minutes then all attempts at resuscitation failed. *Autopsy*: Double ductus arteriosus; congenital atelectasis, moderate; interstitial pulmonary emphysema with extension of emphysema into anterior mediastinum and hemorrhage into posterior mediastinum; bilateral pneumothorax with bulging of diaphragm; tear of tentorium cerebelli (lt.), with hemorrhage into its substance. Acute congestion of spleen, kidney and adrenals; patent foramen ovale.

Private Pavilion. Primaparae. With Scopolamin-Morphin.

No. 4913. Stillborn. Full term. Wt. 3500 gms. Pregnancy normal. Pelvis normal. Position R. O. P. Labor 25 5-6 hrs., terminated by low forceps, double application, preceded by bilateral incision of cervix.

Autopsy: Fracture of squamous portion of temporal bone with extradural hemorrhage; bilateral tentorial tear with hemorrhages into posterior fossae.

No. 5121. Stillborn. Gestation 37 weeks. Wt. 2150 gms. Preeclamptic toxemia of pregnancy. Position M. D. P. Labor 17 1-6 hrs. Low forceps delivery.

Autopsy: Monster. Anencephalus.

No. 5131. Stillborn. Full term. Wt. 3255 gms. Pregnancy normal. Pelvis normal, small. Position L. O. P.

Autopsy: Tear in tentorium cerebelli, bilateral, with hemorrhage into cranial cavity; multiple ecchymoses into falx cerebri and tentorium cerebelli; caput succedaneum with hemorrhage; abrasion through skin over forehead; ecchymoses beneath skin over nose, forehead and cheeks.

Private Pavilion. Multiparae. With Scopolamin-Morphin.

No. 4871. Stillborn. Gestation 36 weeks. Wt. 2670 gms. Pelvis simple flat. Pregnancy with right pyelitis. Previous Cesarean section in 1916. Position S. L. A. Induction of labor by bougies. Labor 17 3-4 hours. Breech extraction after obstructed labor.

Autopsy: Rupture of anterior and posterior atlo axoid and transverse ligaments (broken neck, post-mortem); subcutaneous hemorrhage over vertex; hemorrhage into adrenals and medulla. Interstitial pancreatitis.

No. 4891. Stillborn. Full term. Wt. 3480 gms. Normal pregnancy. Pelvis approaching funnel in type. Position O. L. P. Labor 6 1-3 hours. Perineal forceps delivery. Cord looped over back of neck loosely, passed over chest and under right forearm. Pressure at this point was possible and might have been cause of death. *No autopsy.*

No. 5090. Stillborn. Full term. Wt. 3480 gms. Position R. O. P. Labor 47 2-3 hrs. Contraction ring. Fetus dead in uterus. Labor terminated by craniotomy and extraction. *No autopsy.*

No. 5746. Stillborn. Gestation 39 weeks. Wt. 3000 gms. Pregnancy normal. Position S. D. A. Labor 18 5-6 hrs. Breech extraction. Fetal heart suddenly became very rapid and feeble. Rather difficult extraction.

Autopsy: Bilateral tear of tentorium; acute congestion of lungs, liver and kidneys, with small hemorrhages; hemorrhage into peritoneum and pericardial cavity; patent foramen ovale.

Ward Patients. White Primiparae. Without Scopolamin-Morphin.

No. 4782. Macerated. Full term. Wt. 2770 gms. Pregnancy with myoma of uterus. Position M. L. P. Delivered by podalic version and extraction. Labor 16 3-4 hrs. *No autopsy.*

No. 5566. Stillborn. Gestation 39 weeks. Wt. 3200 gms. Pregnancy normal. Position S. D. A. Labor 5 1-2 hrs. Prolapse of umbilical cord followed by breech extraction. *No autopsy.*

No. 5770. Macerated. Full term. Wt. 3710 gms. Pregnancy normal. Labor 2 hrs. *No autopsy.*

Ward Patients. White Multiparae. Without Scopolamin-Morphin.

No. 4971. Multiple pregnancy. Full term. Labor 12 3-4 hrs. 1st child. Wt. 2840 gms., low forceps, double application; well when discharged from hospital. 2nd child delivered by podalic version; macerated; wt. 2600 gms. *No autopsy.*

No. 5448. Macerated. Full term. Wt. 3040 gms. Pregnancy normal. Position S. L. P Breech extraction. *No autopsy.*

No. 5620. Stillborn. Gestation 42 weeks. Wt. 4400 gms. Pregnancy normal. Labor 2 1-4 hrs. Spontaneous delivery. Fetal heart not heard on admission. No fetal movements for a day before entrance to hospital. *No autopsy.*

No. 5805. Macerated. Full term. Wt. 4890 gms. Pregnancy normal. Labor 21 1-12 hrs. Perineal forceps to deliver macerated head, followed by decapitation, version and extraction. *No autopsy.*

Ward Patients. White Primiparae. With Scopolamin-Morphin.

No. 5021. Stillborn. Gestation 41 weeks. Wt. 4620 gms. Pregnancy normal. Labor 13 1-2 hrs. Low forceps delivery.

Autopsy: Subdural hemorrhage into both anterior and posterior fossae; multiple tears in tentorium cerebelli.

No. 5233. Stillborn. Full term. Wt. 3380 gms. Pregnancy normal. Position L. O. P. Delivered by podalic version. Prolapsed cord. *No autopsy.*

Ward Patients. White Multiparae. With Scopolamin-Morphin.

None.

Ward Patients. Colored Primiparae. Without Scopolamin-Morphin.

No. 4863. Multiple pregnancy. Gestation 38 weeks. 1st child died four hours after birth; wt. 1965 gms. 2nd child well when discharged from hospital; wt. 3015 gms. 1st child delivered by low forceps. 2nd child by podalic version. *No autopsy.* Clinically: Fetal atelectasis.

No. 5061. Died second day after birth. Gestation 37 weeks. Pregnancy normal. Perineal forceps delivery. Labor 8 1-2 hrs. *No autopsy.* Clinically: Intracranial hemorrhage with convulsions, opisthotonus, resistent fontanelle, spaticity of extremities with blood stained spinal fluid.

No. 5255. Died 8 hrs. after birth. Full term. Wt. 3425 gms. Pregnancy normal. Position R. O. P. Podalic version for concealed prolapsed cord. Ordinary attempts at resuscitation failed. Slow heart beat, no respiration. Intracardiac adrenalin given and child began breathing, continued for several hours.

Autopsy: Pneumothorax. Hemopericardium.

No. 5341. Stillborn. Gestation 36 weeks. Wt. 2525 gms. Pregnancy normal. Pelvis simple flat. Induction of premature labor. Labor 17 1-2 hrs. Perineal forceps delivery.

Autopsy: Atelectasis; hemorrhage into abdominal cavity; cardiac puncture with post-mortem leakage; multiple hemorrhages of lung; subcapsular ecchymoses of liver.

No. 5613. Stillborn. Gestation 41 weeks. Wt. 3750 gms. Pregnancy normal. Pelvis generally contracted. Position R. O. P. Labor for 27 1-2 hrs. Prolapse of cord. Podalic version and extraction.

Autopsy: Tear of tentorium with hemorrhage into posterior and middle fossae of cranium. Atelectasis.

No. 5179. Died 48 hrs. after birth. Full term. Wt. 3150 gms. Pregnancy with myoma of uterus. Funnel pelvis. Labor 9 1-12 hrs. Perineal forceps delivery.

Clinically: Hemorrhage disease of newborn; intracranial injury.

Autopsy: Perforation of superior sagittal sinus with hemorrhage into left cranial cavity and over cerebrium; needle puncture wounds of scalp and skin over lumbar spine; hemorrhage into soft tissue about skin punctures, and blood in abdominal cavity.

Ward Patients. Colored Multiparae. Without Scopolamin-Morphin.

No. 5125. Stillborn. Gestation 38 weeks. Wt. 3950 gms. Pregnancy normal. Position M. D. P. Labor 17 1-3 hrs. Delivered by podalic version and extraction.

Autopsy: Tears of falx cerebri and tentorium with hemorrhage into middle fossa of cranium; transverse fractures of both humeri; Greenstick fracture of right clavicle; umbilical hernia; atelectasis.

No. 5149. Macerated. Gestation 36 weeks. Multiple

gestation. Pelvis simple flat. Labor 6 1-3 hrs. 1st child delivered by low forceps; wt. 2250 gms., well when discharged. 2nd child delivered by podalic version; wt. 2250 gms., macerated.

Autopsy: Maceration. Congenital atelectasis.

No. 5158. Stillborn. Full term. Wt. 3590 gms. Pregnancy normal. Pelvis simple flat. Position L. O. P. Labor 35 hrs., terminated by high forceps.

Autopsy: Tears of falx cerebri and tentorium cerebelli with hemorrhage into the posterior and both middle fossae of cranium; fetal atelectasis; hematoma of scalp.

No. 5220. Died 78 hrs. after birth. Full term. Wt. 3050 gms. Pregnancy normal. Pelvis simple flat. Position R. O. P. Labor 9 hrs. Mid-forceps delivery. Spontaneous respiration and cry. Clinically—Subtentorial hemorrhage. Ventricle puncture gave bloody fluid. *No autopsy.*

No. 5665. Macerated. Gestation 34 weeks. Wt. 2550 gms. Pregnancy with syphilis and pyelitis. Labor 17 1-2 hrs. Spontaneous delivery.

Autopsy: Cong. spyhilis; syphilitic osteochondritis; syphilitic pancreatitis; pneumonia alba.

Ward Patients. Colored Primiparae. With Scopolamin-Morphin.

No. 5796. Stillborn. Gestation 38 weeks. Wt. 3050 gms. Pregnancy normal. Position S. L. A. Labor 17 3-4 hrs. terminated by breech extraction. Heart beating at delivery; no respirations. Resuscitation failed.

Autopsy: Atelectasis. Cause of death unknown.

Ward Patients. Colored Multiparae. With Scopolamin-Morphin.

None.

FETAL DEATHS OCCURING IN FOURTH THOUSAND DELIVERIES UNDER 2500 GMS. IN WEIGHT.

Private Patients. Primiparae. Without Scopolamin-Morphin.

No. 4801. Macerated. Gestation 34 weeks. Wt. 1500 gms. Pregnancy with syphilis. Labor 4 5-12 hrs.

Autopsy: Prematurity. Cong. syphilis. Fetal atelectasis. Osteochondritis.

No. 6029. Died 12 hrs. after birth. Gestation 38 weeks. Wt. 1880 gms. Toxemia of pregnancy, pre-eclampsia. Pelvis normal. Labor 12 1-2 hrs. Low forceps delivery. Spontaneous respiration and cry.

TABLE 1.

Fetal Mortality in the Fourth Thousand Deliveries.

Service	Class	Number		Stillborn	Macerated	Died	Total Deaths	Percent
Entire	Wh. Primip.	318	Seminarcosis	7	2	0	9	2.2
"	Col. Primip.	84		3	0	4	7	8.4
"	Wh. Multip.	471	With	6	3	2	11	2.3
"	Col. Multip.	111	and	3	4	4	8	7.27
	Total	984	Without	19	9	7	35	3.6
Entire	Wh. Primip.	239		5	0	0	5	2.1
"	Col. Primip.	51		1	0	0	1	1.9
"	Wh. Multip.	211		4	0	0	4	1.9
"	Col. Multip.	24	With	0	0	0	0	.0
	Total	525		10	0	0	10	1.9
Entire	Wh. Primip.	79		2	2	0	4	5.0
"	Col. Primip.	33		2	0	4	6	18.0
"	Wh. Multip.	260		2	3	2	7	2.7
"	Col. Multip.	87	Without	3	4	1	8	9.2
	Total	459		9	9	7	25	5.4

TABLE 2.

Mortality in Second, Third and Fourth Thousand Deliveries Combined.

Service	Class	Number		Stillborn	Macerated	Died	Total Deaths Number	Total Deaths Percent
Entire	Wh. Primip.	1063	Seminarcosis	17	2	10	29	2.7
"	Col. Primip.	197		11	2	5	18	9.8
"	Wh. Multip.	1465	With	13	7	10	30	2.1
"	Col. Multip.	229	and	7	8	2	17	7.8
	Total	2954	Without	48	19	27	94	3.2
Entire	Wh. Primip.	844		11	0	10	21	2.4
"	Col. Primip.	120		7	1	0	8	6.6
"	Wh. Multip.	633		9	0	2	11	1.7
"	Col. Multip.	62	With	2	1	1	4	6.5
	Total	1659		29	2	13	44	2.6
Entire	Wh. Primip.	219		6	2	0	8	3.6
"	Col. Primip.	76		4	1	5	10	1.3
"	Wh. Multip.	832		4	7	8	19	2.2
"	Col. Multip.	168	Without	5	7	1	13	7.7
	Total	1295		19	17	14	50	3.9

No. 5668. Macerated. Full term. Wt. 3050 gms. Pregnancy with syphilis. Pelvis generally contracted. Labor 5 hours.

Autopsy: Cong. syphilis.

No. 5850. Stillborn. Full term. Wt. 5210 gms. Pregnancy normal. Pelvis generally contracted. Labor 8 1-3 hrs. Spontaneous delivery of head; difficulty delivering shoulders.

Autopsy: Multiple hematomata of scalp and epicranium; overriding of bones of skull; atelectasis; patent ductus arteriosus; patent foramen ovale.

No. 6024. Macerated. Gestation 38 weeks. Wt. 3170 gms. Pregnancy normal. Pelvis flat rachitic. Position L. S. P. Labor 14 5-6 hours. Breech extraction. *No autopsy.*

Convulsions with signs of intracranial injury. *No autopsy.*

No. 5894. Macerated. Gestation 39 weeks. Wt. 1780 gms. Pregnancy with myoma of uterus. Position S. D. A. Spontaneous delivery.

Autopsy: Intrauterine death from unknown cause, with post-mortem autolysis.

Private Patients. Multiparae. Without Scopolamin-Morphin.

No. 5376. Died 3 hrs. after birth. Gestation 32 weeks. Wt. 1580 gms. Pregnancy with syphilis. Pelvis normal. Labor 8 25-60 hrs.

Autopsy: Cong. Syphilis; atelectasis; osteochondritis; interstitial pancreatitis; pneumonia alba; duboid abscess of thymus.

No. 5541. Macerated. Full term. Wt. 2200 gms. Pregnancy normal. Pelvis simple flat. Labor 3 55-60 hrs. *No autopsy.*

Private patients. Multiparae. With Scopolamin-Morphin.

None.

Private aPtients. Multiparae. With Scopolamin-Marphin.

No. 5934. Died 5 hrs. after birth. Gestation 35 weeks. Wt. 1880 gms. Pregnancy with pyelitis. Pelvis normal. Labor 6 1-2 hrs. Low forceps delivery. Spontaneous respirations and cry.

No autopsy. Clinically—Prematurity.

TABLE 3.

The Fourth Thousand Cases Delivered at Barnes Hospital.

Class	No.	Stillborn	Macerated	Died	Total	Pc.
Ward Service With.						
White Primip.	103	2	0	0	2	1.9
White Multip.	87	0	0	0	0	.0
Col. Primip.	51	1	0	0	1	1.9
Col. Multip.	24	0	0	0	0	.0
Total	265	3	0	0	3	1.1
Private Pavilion Service With.						
Primiparae	136	3	0	0	3	2.2
Multiparae	124	4	0	0	4	3.2
Total	260	7	0	0	7	2.7
Ward Service Without.						
White Primip.	41	1	2	0	3	7.3
White Multip.	186	1	3	0	4	2.1
Col. Primip.	33	2	0	4	6	18.
Col. Multip.	87	3	4	1	8	9.2
Total	347	7	9	5	21	6.
Private Pavilion Service Without.						
Primiparae	38	1	0	0	1	2.6
Multiparae	74	1	0	2	3	4.
Total	112	2	0	2	4	3.5

Ward Patients. White Primiparae. Without Scopolamin-Morphin.

No. 5616. Stillborn. Gestation 34 weeks. Wt. 1975 gms. Acute nephritis of pregnancy. Labor 1 1-2 hrs.

Autopsy: Prematurity. Atelectasis.

Ward Patients. White Multiparae. Without Scopolamin-Morphin.

No. 5473. Stillborn. Gestation 30-32 weeks. Wt. 1910 gms. Pregnancy normal. Labor 6 1-2 hrs. Membraneous insertion of cord; partial premature separation of placenta. *No autopsy.*

No. 5635. Died 12 hrs. after birth. Gestation 34 weeks. Wt. 1650 gms. Pregnancy with pyelonephritis. Labor 9 5-6 hrs. Spontaneous delivery. *No autopsy.*

No. 5722. Still born. Gestation 35 weeks. Wt. 1545 gms. Pregnancy normal. Position Sc. D. A. Labor 7 1-6 hrs., terminated by podalic version and extraction. *No autopsy.*

No. 5834. Stillborn. Gestation 36 weeks. Wt. 1780 gms. Pregnancy with chronic pulmonary tuberculosis and pyelitis. Labor 8 1-2 hrs. Spontaneous delivery.

Autopsy: Prematurity; tear in left tentorium; atelectasis; patent foramen ovale; patent ductus arteriosus.

Ward Patients. White Primiparae. With Scopolamin-Morphin.

None.

Ward Patients. White Multiparae. With Scopolamin-Morphin.

None.

Ward Patients. Colored Primiparae. Without Scopolamin-Morphin.

No. 5454. Stillborn. Gestation 29 weeks. Wt. 1600 gms. Toxemia of pregnancy. Labor 26 25-60 hrs.

Autopsy: Prematurity.

Ward Patients. Colored Multiparae. Without Scopolamin-Morphin.

No. 5184. Stillborn. Gestation 30 weeks. Wt. 1500 gms. Pregnancy with syphilis, malaria, simple anemia.

Autopsy: Hemorrhage into both middle fossae of cranium and into substance of falx cerebri and tentorium cerebelli; Fetal atelectasis; stenosis of left ureter with hydronephrosis.

No. 5622. Died one hour after birth. Gestation 34 weeks. Wt. 1785. Pregnancy normal. Labor 22 1-2 hrs. Spontaneous delivery. Asphyxia. Heart beat continuous for one hour.

Autopsy: Atelectasis, partial; prematurity.

No. 5970. Multiple pregnancy. Gestation 35 weeks. Pregnancy normal. Labor 7 5-6 hours.; Spontaneous delivery of 1st child; wt. 2335 gms; well at discharge. Spontaneous delivery of 2nd child; stillborn; wt. unknown. *No autopsy.*

Ward Patients. Colored Primiparae. With Scopolamin-Morphin.

None.

Ward Patients. Colored Multiparae. With Scopolamin-Morphin.

No. 5917. Died 3 hrs. after birth. Gestation 39 weeks. Wt. 2275 gms. Pregnancy normal. Funnel pelvis. Labor 17 hrs. Spontaneous delivery. Umbilical cord tight around neck; prolapsed cord. No fetal heart beat. After intracardial adrenalin and intratracheal insufflation child gasped and breathed for about five hours.

Autopsy: Prematurity; atelectasis; fatty degeneration of liver.

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PULMONARY COMPLICATIONS OF SURGERY.*

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Within a three year period, in the Toronto General Hospital, pulmonary complications ensuing upon operations placed one hundred and twenty lives in jeopardy and caused the death of forty excellent surgical risks. Pulmonary complications following operations are then something to be seriously reckoned with, since two to three of every one hundred cases subjected to operation may be counted upon to develop some chest condition. These pulmonary complications inevitably bring the anesthetist to the bar and it is fitting that he know accurately the details of the crime of which he is so often adjudged ***guilty***.

ROLE OF THE ANESTHETIST.

Were I an anesthetist upon whom the charge was being laid that my administrations had caused pulmonary damage I should at once retort—show me that signs and symptoms of pulmonary disorder began within seventy-two hours of operation or I can justly disclaim responsibility, and, further, if beginning in seventy-two hours show me that the possibility of embolism, infarct, fat embolism and collapse of the lung have been considered or I may at least claim a verdict of not proven.

My claim for acquittal would be based upon the actual state of affairs as recognizable, for lung lesions beginning after seventy-two hours are rarely inflammatory and irritative or due to developing infection, but are more distinctly embolic in nature and have a history and course distinctive to a degree. The anesthetist has no responsibility in their connection. My claim for a not-proven verdict in

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some of the early occurring lesions rests upon the fact that some lung conditions developing within a few hours to seventy-two hours of the operation, are often due to embolus, infarction, and collapse of a lung, yet rarely are these conditions separated from the more common broncho-pneumonias unless the clinical course is stormy to a degree. In a certain percentage of these early occurring cases the anesthetist is an innocent bystander.

Inflammatory and Embolic Complications

Ether pneumonia has long been a term of reproach and practically every condition occurring in the chest after operation has been labelled pneumonia. A little consideration of symptoms and findings shows that lung complications are of two distinct sorts, *inflammatory* and *embolic*. The *inflammatory*, including the still unconsidered collapse of a lung, occurs early, within seventy-two hours, and are probably related to the general anesthetic; the *embolic* may occur at any time, but more particularly from the fourth day on; although the emboli of fat may give rise to symptoms during the operation itself.

Emboli of course premise the existence of a thrombosis. Sudden death, or death after a struggle of a few hours with the symptoms of acute respiratory or circulatory distress are the classical symptoms of a large pulmonary embolism. Acute pleural pain is to be looked upon as a symptom, just as classical, of minor embolism, a condition the existence of which is too generally overlooked.

Be it remembered that thrombosis and pulmonary embolism are the most common causes of death after the removal of large uterine or pelvic tumors; that the superfical and deep epigastric veins are frequently wounded and become thrombosed; that cases of femoral thrombo-phlebitis following clean abdominal operations comprise nearly fifteen per cent. of the phlebitis cases entered into hospital records; that thrombosis of abdominal veins is often found though unsuspected, and that abdominal symptoms after abdominal operations are frequently due to thrombi in the abdominal veins.

Of one hundred and twenty instances of pulmonary complications in our series fifteen are embolic.

In addition to thrombo-embolism must be definitely considered embolism of fat. Roswell Park's classical descriptions have been forgotten; fractures, bone operations requiring much tapping or chiselling, regularly drive fat into the circulation; hernial repairs, operations through abdominal fat are the most frequent forerunners of fat emboli, a happening of the early hours of the operation and after history, whose clinical signs are usually taken as indicating acute circulatory failure or diffuse bronchiolitis with fever and cyanosis.

To the aid of the anesthetist will often come the post mortem room's most interesting testimony. The unsuspected thrombus is perhaps the most important witness; the free-floating fat in the lung base may explain the sudden cyanotis death better than heart failure. Massive collapse, a new arrival in the field of pulmonary pathology cannot be looked upon as one of anesthesias crimes. It is, however, a condition established and of surpassing interest and, heretofore, has been branded "Ether Pneumonia." Unilateral consolidations should be closely questioned. Even the abscesses testify for you. Nothing can contradict the fact that 8 of these followed upon teeth extractions and operations upon the esophagus, nose and throat; 4 others have the history of emboli which later became infected and only 4 of the 16 followed straight upon the broncho-pneumonic type of lung lesion.

Abdominal operations are the predisposing cause of pulmonary complications as less than four per cent. of the recorded cases of the postoperative broncho-pneumonias, the pleurisies, the emboli and collapse of the lung follow operations on the extremities head or chest, something more than the anesthetic then is evidently at work. No anesthetist should be ignorant of the literature on thrombophlebitis and pulmonary complications, nor of W. Pasteur's description of collapse of the lung following abdominal operations, and if he has failed to appreciate the meanings of acute pleural pain, of femoral phlebitis, and of respiratory distress ensuing abruptly during and after certain operations, he is indeed negligent of his own security and of his proper self-interest.

The Relation of the Anesthetic.

The relation of the anesthetic to the ensuing complications is naturally the point of main interest; every anesthetic has postoperative pulmonary accidents if there has been an abdominal operation, a large dissection or trauma covering a large surface; lung affections may follow local anesthesia, but it is difficult to think that these can be inflammatory or due to infections. A careful analysis shows that the accidents subsequent to local anesthesia are embolic or are associated, with conditions suggesting processes other than simple broncho-pneumonia.

Five of our cases of pulmonary complications subsequent to operation are recorded as following local anesthesia, and these cases show how carefully any statistics must be analysed:—

Case 91—Fracture of the patella, operation under local anesthesia; slight fever with elevation of pulse and respiratory rate at once, lasting three days; no lung signs; fourteen days later, pleurisy, pain and rub in the left axilla, area of consolidation.

Case 86—Chondroma of rib; resection, fever at once which was ascribed to a bronchitis; pain in the chest, heart drawn to the left, physical signs of consolidation which with the displacement of the heart

would probably indicate a collapse of the lung.

Case 67—Gastro-enterostomy; consolidation of the left lower lobe after operation; it was noted "that the trachea was drawn to the left.' As hearts and trachea are not drawn to one side or other in the more simple conditions of postoperative broncho-pneumonia and bronchitis, some other process is suggested, probably that of an associated collapse.

Case 80—Colostomy; postoperative bronchitis diagnosed as the cause of the ensuing fever and distress. Autopsy reveals a peritonitis.

Case 40—Intestinal obstruction; operation; death 6 weeks later from a hypostatic pneumonia.

DIFFERENTIAL CONSIDERATIONS.

In few collections of cases is the distinction made between the quick developing broncho-pneumonic lesions and the later occurring lesions due to emboli of moderate size from unsuspected thrombus formation or even from some more outspoken thrombosis, yet from the anesthetist's point of view this is all important, he is involved perhaps in the production of the first, he is innocent of any connection with the second. Fever at once or rapidly rising after the operation, increase of pulse and respiratory rate with absence of pleural pain in the early hours of recovery from the anesthetic, suggest the developing broncho-pneumonia or bronchitis; fat embolism and collapse of the lung must be thought of; the absence of pleural pain, almost a fixed rule in the broncho-pneumonic cases, suggests that the process is beginning within the substance of the lung: slight persisting fever after the operation, with no lung signs or symptoms for the first few days, then followed by acute pleural pain, rub, or signs of consolidation means embolism whose diagnosis is often furthered by the appearance of a thrombo-phlebitis;—the acute pleural pain has this elemental importance, the patient will probably live, the embolus is small and the inflammatory reaction shows that the patient has survived the shock; the thrombo-phlebitis and edema can usually also be looked on as an olive branch,—the thrombus is anchored.

In all fairness to the patient and surgeon we must admit that the combination of general anesthetic and abdominal operation seems to be the one to give rise most frequently to broncho-pneumonia, and bronchitis,—irritative lesions—these types of lung affection after operation, do seem to be more frequent in the winter and spring; inhalation, irritation and infection are, however, merely added insults to a lung whose circulation and ventilation are already interfered with by the operation itself, by the anesthetic perhaps and by the abdominal pain with splinting of muscles and diphragm; the operation near the diaphragm, the irritation of inhaled secretions and anesthetic (if this latter premises is admitted, I freely grant it is questionable though ether is an irritant to the respiratory tract) can both be counted upon to promote the development of infarction subsequent to the multitude of minute emboli which begin to wander from the veins of the operation field to the lung; by themselves these small emboli are harmless and soon absorbed; in experiments it is noted that emboli must be larger than a radish seed to produce an infarct, unless the chest is bruised or the lung irritated, when infarction is easily produced. The general anesthetic can never quite escape suspicion of complicity in this class of cases, though the close linking up of postoperative pulmonary complications with abdominal operations shows that other causes are at work.

Careful weighing of evidence in the abdominal cases operated on under a local anesthetic, will, I am sure, reveal the fact that the lung complications do not suggest broncho-pneumonia or bronchitis but rather conditions resembling massive collapse, gross emboli, or minor emboli occurring late and associated with pleural pain; this has not been insisted upon sufficiently and the diagnosis of postoperative pneumonia or broncho-pneumonia is still made in cases whose history is obviously that of thrombosis and embolism, conditions by which even the local anesthetic can not successfully steer our patients.

48 BLOOR ST., E.

The Eastern and Mid-Western Anesthetists will hold a Joint Annual Meeting during Clinical Congress of Surgeons Week at the Hotel Adelphia, Philadelphia, October, 26-30. Features of the program will be Guest Sessions with the Academy of Stomatology and the American Society of Regional Anesthesia. For further details write either of the Secretaries, Dr. Chas. J. Wells, 1932 S. Salina St., Syracuse, N. Y., or Dr. Ralph M. Waters, 515 Wirthman Bldg., 31st and Troost Sts., Kansas City, Mo. Aside from the scientific sessions there will be clinics and laboratory demonstrations as well as a Dinner-Dance and delightful entertainments for the visiting ladies. Make your plans now to attend and bring your associates in the specialty with you and get them to join the regional society in which they are located.

The Southern Association of Anesthetists will meet during the week of the Southern Medical Association at the Jefferson Hotel, Dallas, Texas, November 10-11, and you are invited and urged to attend. For further information and details write the Secretary, Dr. Wm. Hamilton Long, 1911 Duker Ave., Louisville, Ky., who also still has some vacancies on the program for those who wish to present papers. All anesthetists South of the Mason-Dixon Line are urged to become members of the Southern Association of Anesthetists and derive the benefits accuring from the organization of the specialty and the regional meetings.

DETERMINING THE SAFE OPERATING TIME IN NEUROSURGICAL CONDITIONS.*

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It is only within recent years that there has been any comparatively safe operating time in neurosurgical conditions and this was equally true of both the acute and chronic cases. A tremendous advance, however, has been made in the accurate diagnosis and the appropriate treatment of these cases during the past twenty years; this progress has been due to three main causes: *First,* the pioneer work of men like Horsley, Krause, VonEiselberg and in this country of Keen and Hartley, and more recently Cushing and now a group of younger men throughout the country all making valuable contributions to this field of work; *second,* better team-work between the neurologist and the neurosurgeon, so that earlier diagnoses are more probable and the patient is less damaged by the time operative treatment is advised —the surgeon himself understanding at least the principles of neurology; and *thirdly,* an improved surgical technic, making possible the operative treatment of lesions of the central nervous system with a comparatively low mortality and the patient in at least an improved condition after the operation. A careful, light anesthesia is essential—local anesthesia being used whenever possible.

DISCOURAGING AND ENCOURAGING FIELDS.

In this connection it may be stated that the discouraging field of neurosurgery from the standpoint of the end-results consists in the treatment of brain tumors on account of their high percentage of malignancy—almost 80%; of brain abscess—a subcortical lesion, with a mortality of 70%; and of the condition of internal hydrocephalus, a complete blockage of the ventricles (and not the usual condition of external hydrocephalus in which the treatment is encouraging), owing to the great difficulty and at present the impossibility of establishing satisfactory ventricular drainage.

On the other hand, the encouraging field of neurosurgery consists of the treatment of trifacial neuralgia by the severance of the posterior sensory root of the Gasserian ganglion with a mortality of less than 2%; the repair of traumatic lesions of the peripheral nerves and of the brachial plexus, particularly those lesions occurring at the time of birth and thus named brachial birth palsies; surgical lesions of the spinal cord in that the tumors are much less frequently malignant than those of the brain and the traumatic conditions may not have caused a primary injury to nerve tissue itself—the impairment being secondary to spinal cord compression of bone, hemorrhage or merely edema itself; and lastly, but most encouraging of the entire field of neurosurgery, the treatment of brain injuries with and without a fracture of the skull.

In the operative treatment of chronic neurosurgical conditions, naturally all efforts are directed toward having the patient in the best possible condition to survive the operative procedure and a preparatory period of several days is of little or no importance and in nowise lessens the good result to be obtained. This is not true of the acute neurosurgical conditions of emergency service and among these various emergency conditions, brain and spinal cord injuries predominate. I shall limit my remarks to these conditions.

ACUTE BRAIN INJURIES.

The diagnosis and treatment of acute brain injuries in adults has been retarded very much by the nomenclature "fracture," when it is now well known that the presence or not of a fracture of the skull is possibly the most unimportant part of the pathology of cranial injuries, both in the diagnosis and in the treatment to be afforded to the patient. (Naturally all depressed fractures of the vault should be elevated or removed for fear of future complications of cortical irritability, etc., and these depressed fractures will not be considered in this paper).

On the other hand, the most important pathology to be considered in brain injuries is the presence or not of an increased intracranial pressure, whether due to hemorrhage or to cerebral edema. If hemorrhage is present and of not sufficient amount to cover the convolutions themselves, then this fluid blood is found in the sulci about the supracortical veins; it is this blood, if not absorbed or satisfactorily drained, that permits an organized-residue to form and thus to become an obstruction of varying degree to the future absorption of the cerebrospinal fluid. In the diagnosis of these conditions, the routine neurologic examinations are aided by careful ophthalmoscopic findings of the fundi and by accurate estimations of the intracranial pressure by the method of lumbar puncture, as registered by the spinal mercurial manometer. But no patient should be subjected to prolonged examinations and tests, if that patient is in a condition of shock, for such examinations will not aid the shock of the patient but rather prolong it, and our first consideration should be the general treatment of shock when present.

In the treatment of these acute brain injuries I have had an opportunity to examine a large series of them (over 1,000) and in this series the expectant palliative treatment of quiet, ice helmet, warmth, shock measures, etc., was successful in almost two-thirds, 56% of them. This expectant treatment was frequently aided by the spinal drainage of repeated lumbar punctures and these were the patients, in

*Read during the Fourth Annual Congress of Anesthetists, the Associated Anesthetists of the United States and Canada in Joint Meeting with the International Anesthesia Research Society, The Breakers, Atlantic City, May 25-28, 1925.

whom the increased intracranial pressure did not exceed twice the normal, the normal pressure being 6-8 mm. of Hg, as registered by the spinal mercurial manometer. The use of concentrated solutions of magnesium sulphate to lessen the cerebral edema has not been effective in my own experience in these acute cases, but this method has proved of value in the chronic cerebral edemas associated with the condition of brain tumor, etc., in which the cerebral edema is rather an intracellular true edema than the "wet" edematous brain so frequently associated with brain injuries.

The *operative treatment* in this series was necessary in less than one-third (30%) of the cases and was advised only in those patients having an increased intracranial pressure of over twice the normal and in whom the expectant palliative method of treatment, together with repeated lumbar punctures of spinal drainage, failed to lower the pressure. The operation of choice was the subtemporal decompression and cranial drainage. Those patients entering the hospital in a moribund condition and dying within 6 hours after admission from shock, medullary edema (decompensation), other internal injuries, and for whom no operative treatment was naturally advised, numbered almost one-seventh (14%), in this series. The total mortality was 33% and if we subtract the 14% of moribund cases, the mortality is lowered to 19%. The operative mortality was 39% and naturally these patients operated upon were the more seriously injured, not only from the standpoint of recovery of life but from the standpoint of future normality. The operative treatment depended upon a marked increase of the intracranial pressure of more than twice the normal, whether this increased pressure was due to hemorrhage or to cerebral edema and these two factors form the most common and important pathology in brain injuries, it being rare (in only 6% of the cases) for a gross primary lesion of the brain, such as laceration and subcortical hemorrhage, to occur.

Contraindications to Operation.

In the operative treatment of brain injuries, there are two periods in which no operation should be performed and it has been the neglect of this fundamental consideration that the operative treatment of selected cases of brain injuries had become almost discredited until within the past few years. The first period in which no operation should be performed is during the initial stage of shock, when the temperature is subnormal and the pulse and respiration rates are above 120 and 34, respectively, and the blood pressure below 100. To advise a cranial operation or even extensive prolonged examinations and tests upon these patients in the condition of severe shock merely lessens the chances of recovery and if the patient does survive, then he recovers in spite of the additional shock of the examination and of the operation.

The second period during which *no* operation should be performed may be termed the terminal one of medullary edema (decompensation), characterized clinically by rapidly increasing pulse and respiration rates and rising temperature, but by a failing blood pressure. The patient may have been "doing nicely" for a period of several days and then he changes rapidly, so that the picture approximates the clinical syndrome as described above, and then, since it is feared the patient will die, it is often thought advisable to give him a chance, but these patients always die, having the condition of medullary edema, whether operated upon or not—the operation merely hastening the exitus.

However, in the treatment of patients having brain injuries, their intracranial status can be most accurately estimated by repeated lumber punctures and ophthalmoscopic examinations and in this manner the clinical signs of medullary compression, such as retarded pulse and respiration rates and a possible increasing blood pressure, can usually be anticipated and thus the dangerous condition of medullary edema be prevented by the rational treatment of early subtemporal decompression and cranial drainage in that small percentage of selected cases having a high intracranial pressure (less than one-third of all cases). The use of repeated lumbar punctures of the cisterna magna for the drainage of subtentorial hemorrhage with marked signs of medullary compression may be of great value in selected cases.

Differences in Children.

The diagnosis and treatment of acute brain injuries in children under 12 years of age are the same as in adults, except that the operative method of treatment to lower a marked increase of the intracranial pressure due to hemorrhage or to cerebral edema is much less frequent, owing to the fact that acute cerebral edema following cranial injuries in children occurs comparatively rarely. Apparently the intracranial vascular mechanism of the child adjusts itself much more rapidly and easily to the effects of cranial trauma, so that an increased amount of cerebrospinal fluid is either not secreted or, if secreted in large amounts, then the excess is absorbed without difficulty, so that the condition of acute cerebral edema only occurs in the extreme cases. For this reason, the operative treatment of acute brain injuries in children has only been necessary in 16% of the patients, whereas in adults the operative treatment was advised in 30%. It may be stated also that children will stand the effects of brain injuries much better than adults and I believe this is also due to the less frequent occurrence of extensive cerebral edema in them.

In the treatment of extensive intracranial hemorrhage in the newborn, the presence of severe shock

is a definite contraindication for any prolonged examinations, tests, etc., and all treatment should be directed toward the recovery of the general condition of shock rather than permitting the baby to run the great risk of having the shock increased by local examinations, neurologic tests, etc., and thus hastening the exitus. In a recent series of 500 consecutive newborn babies upon whom a lumbar puncture was performed within 12 to 24 hours after birth in order to ascertain the frequency of intracranial hemorrhage of varying degree, 45 babies, that is 9%, had bloody and blood-tinged cerebro-spinal fluid, but no test was made if the baby was in a severe condition of shock and no ill-effects in any of the babies were observed.

The danger of lumbar puncture in these acute cases in shock occurred in one case only in another series of my cases: the lumbar puncture was performed upon a newborn baby in an extreme condition of shock; after the test the child's cry became weaker and although a later autopsy revealed multiple cranial fractures and extensive extra- and intracranial hemorrhage of sufficient amount to cause the death of the baby, yet I believe the lumbar puncture increased the shock and hastened the exitus.

In the mentioned series of 500 consecutive cases, no cranial operation was performed—merely repeated lumbar punctures of spinal drainage in the babies having bloody cerebro-spinal fluid and naturally the cranial operation would be indicated in only the extreme cases of extensive hemorrhage and not during the period of shock. A detailed report of these observations is to be presented before another section at this meetting.

In acute conditions of spinal cord lesions and particularly those affecting the cervical segments, the two periods of severe initial shock and terminal medullary edema in which no operation should even be considered, must always be remembered; extensive neurological examinations should be postponed until the signs of severe shock have disappeared; the knowledge of the neurologic lesion to be obtained by careful physical examinations, lumbar punctures, combined cisterna magna—lumbar puncture observations, etc., are of great interest to the physician and yet the patient must be in a satisfactory general condition to avoid being made worse by these methods of examination.

Conclusions.

Owing to improved surgical technic, more careful hemostasis and a strict asepsis, and to better teamwork in the operating room with special attention to the anesthesia and a careful regard for the periods when no operation should be performed, the mortality of all cranial operations has been lowered to approximately 18% and of all spinal operations to approximately 9%.

20 W. 50th St.

REDUCING THE SURGICAL RISK IN INTESTINAL OBSTRUCTION*

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The important relationship between chemistry and biology and the practical therapeutics of medicine is rapidly becoming more and more evident as one studies modern medical progress. The human body, being a highly complicated chemical organism, lends itself to unlimited investigation in its many and varied diseased conditions. The chemistry of anesthesia in its broadest sense is certainly a subject worthy of deepest investigation because of its bearing upon the operability of patients. To better prepare patients for anesthesia and operation has been one phase of our experimental studies in intestinal obstruction.

Earlier Studies.

We early found in obstructions of the upper intestinal tract that certain chemical changes in the blood and urine were constant[1 2]. We further found that these chemical changes were indicative of the degree of toxemia of such obstruction and offered suggestions for combating or preventing this toxemia[3].

Ligation of the pylorus in a dog causes a rise in the non-protein nitrogen content, a rise in the carbon dioxid combining power and a fall in the chlorides of the blood with a coincident increase in the non-protein nitrogen and diminution of the chlorides in the urine. Similar changes are noted in duodenal and upper jejunal obstructions.

These striking changes in the chemistry of the blood and urine indicate some metabolic disturbance, which, if permitted to progress beyond a certain point, produces death. The increase in the non-protein nitrogen of the blood and urine is evidence that there is a destruction of the body protein tissue in excess of the normal. The fall in the blood chlorides is somewhat more difficult of explanation. It has been suggested that the chlorides have been lost by excessive vomiting,[4] but this is not the whole explanation because rabbits show the same chloride changes and cannot vomit. One of our clinical cases showed the typical changes and did not vomit. The diminution of the chlorides in the blood and urine suggests their utilization by body tissues or possibly as a neutralizing agent in the course of the toxic process initiated by the intestinal obstruction. It has been a very interesting observation that the chlorides show considerable decrease in the blood before there develops any striking increase in the non-protein nitrogen. It has then seemed possible

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that the chlorides have been, in some way utilized to delay the protein destruction and after a certain point is reached have become exhausted, permitting the protein destruction to advance more rapidly. The increase in the carbon dioxid combining power of the blood is an indication of an increase in the blood alkali. It is possible that this may be the result of a combination between sodium freed from sodium chlorid and carbonic acid which produce sodium bicarbonate. In the very toxic cases a very striking *alkalosis* is observed.

Treating the Toxemia

These blood findings have been interpreted as direct evidence of the degree of toxicity present. If this is true a method to combat the toxemia then becomes the problem. Since a fall in the blood chlorides seemed to be a result of their use or destruction somewhere in the development of the toxemia, the natural suggestion was then made that perhaps the administration of chlorid would inhibit or prevent the development of the toxemia and hence become a means of treatment of the toxemia of intestinal obstruction.

Experiments were carried out to note the effect of administration of chlorides upon the toxemia. Dogs with duodenal and jejunal obstructions were used. The chlorides were administered in most instances, by hypodermoclysis in strengths from 0.89% to 3% depending upon the blood chlorides. By giving sodium chlorid in sufficient quantity after the toxemia developed the non-protein nitrogen and chlorides of the blood could be returned to within normal limits. Likewise the development of the toxemia could be prevented by giving chlorides daily beginning the day the obstruction was produced. We were able to keep dogs alive 27 to 30 days by a daily hypodermic dosage of physiologic sodium chlorid solution in a quantity equal to 40 c. c. per kilo of body weight. To eliminate the effect of water alone dogs of approximately the same size were given the same dosage of distilled water. The distillled water did not in any way prevent the development of the toxemia nor did it in any instance prolong the life of the animal beyond the length of life when no treatment was given.

In a series of dogs we have obstructed the jejunum 12 inches below the duodenum and later treated them by entero-enterostomy alone, entero-enterostomy with distilled water and entero-enterostomy with sodium chloride both before and after the relief of the obstruction[5]. The dogs treated by intestinal anastomosis alone all died. Those given distilled water died as promptly as those given no treatment. The dogs given sodium chlorid both before and after the entero-enterostomy fared much better. Eight of ten such dogs recovered completely.

We have recently injected varying strengths of salt solution into an enterostomy tube placed in the gut distal to the obstruction with the result that toxemia is inhibited and life much prolonged[6].

These findings strongly suggest that sodium chlorid acts as a protecting agent against the toxemia of intestinal obstruction. In clinical cases of pyloric and small intestinal obstruction the changes in blood and urine non-protein nitrogen and chlorides were similar to those in experimental animals. Treatment with sodium chlorid produced excellent clinical results. In one patient the obstruction released itself after treatment with salt solution and operation was avoided. Dixon[7] has recently reported five cases of duodenal obstruction treated with sodium chlorid in which he records excellent results. McVicar[8] studied thirty cases of high intestinal tract obstruction with typical blood chemical findings. Twelve of his patients had tetany. He emphasizes the value of treatment with sodium chlorid, glucose and water.

Reduction of Operative Risk

These observations have a direct bearing upon the reduction of the operative risk in pyloric and intestinal obstruction. If the administration of chlorides diminishes the toxemia they should then be given in all cases before anesthesia and operation. All anesthetists and surgeons appreciate the dreadful mortality in the very ill patients with intestinal obstruction. Such patients need, most of all, treatment of their toxemia and dehydration and need it before the extra load of anesthesia and operation is placed upon them. Operation should not be too long delayed for such treatment. A few hours at the most is sufficient time when it is evident that surgery is necessary.

In the very toxic cases we have estimated that about one gram of sodium chlorid per kilo (2.2 lbs.) of body weight is sufficient for the initial dose. This would be about 70 grams for an average sized person of 150 lbs. With this should be given two to four liters of water. It is desirable to introduce this salt and water as rapidly as is possible with safety. It may be given by hypodermoclysis, intravenously or by rectum. Proctoclysis is the poorest method in the very ill because the very ill patients retain it poorest and it is often impossible to determine accurately the quantity taken in a given time. The other two methods are efficient, fairly rapid and accurate. Both may be used if necessary. Solutions with strength varying from 0.8 to 3 per cent. may be used under the skin with satisfaction. The stronger the solution the more slowly it should be given. A 5 per cent. solution may be given slowly in the vein with good results. The continuous intravenous drip of Matas[9] may be used.

After this preliminary treatment the general improvement in the patient is usually noticeable and it is at this time operation may be done.

The preoperative treatment and operation by no means ends the therapy. The water and salt should

be resumed immediately following the operation and continued as long as needed. The quantity of chlorid given should be checked by blood and urine chlorid determinations when possible. In the absence of such facilities the general condition of the patient must furnish the evidence. As long as the patient has a dry tongue and thirst, water and sodium chlorid are needed.

CONCLUSIONS.

1. Patients with acute obstruction of the pylorus and small intestine show typical blood and urine chemical changes which are indicative of the degree of toxemia.

2. From the therapeutic standpoint the fall in the chlorides appears to be the chief factor in the chemical changes and suggests treatment with chlorides to combat the toxemia.

3. All patients with acute intestinal obstruction should have preliminary treatment with water and sodium chlorid before anaesthesia and operation.

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LAWLLER BLDG.
47TH ST. AT MILL CREEK PARKWAY.

The Southern Association of Anesthetists will meet during the week of the Southern Medical Association at the Jefferson Hotel, Dallas, Texas, November 10-11, and you are invited and urged to attend. For further information and details write the Secretary, Dr. Wm. Hamilton Long, 1911 Duker Ave., Louisville, Ky., who also still has some vacancies on the program for those who wish to present papers. All anesthetists South of the Mason-Dixon Line are urged to become members of the Southern Association of Anesthetists and derive the benefits accuring from the organization of the specialty and the regional meetings.

PROPHYLACTIC BLOOD TRANSFUSION AS A ROUTINE MEASURE IN POOR OPERATIVE RISKS.*

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Blood transfusion is today a familiar procedure in every hospital, thanks to the work of Crile, Moss, Linderman, Lewisohn, Unger and many others, who have simplified and perfected the technic so that it is now a comparatively safe and most valuable therapeutic measure.

The procedure is also familiar to the laity due to the frequent exploitation by the daily press of such good news copy as *heroism* displayed by relatives or friends in sacrificing their blood to save one dear to them.

But to some of the profession and to the lay mind certainly, blood transfusion is still regarded as a measure of resort in desperate cases only, such as severe anemias and profound postoperative shock from hemorrhage.

PROPHYLACTIC CONSIDERATIONS.

I wish to call attention to the great value of blood transfusion as a prophylactic preparatory measure in patients who are to undergo any severe or prolonged operation, where shock or considerable loss of blood may be anticipated, and also in patients who are to have minor operations involving blood loss and who have a lowered resistance, due to anemia or other causes.

Gynecological patients more than any others are most likely to have an associated secondary anemia of varying degree, due of course to the menorrhagias or metrorrhagias so frequently present in uterine or adnexal disease. Thus in the Woman's Hospital in New York, we perhaps see a larger proportion of patients with anemia who have to undergo operation than is usual in a general hospital. The cases with fibroids, carcinoma uteri, idiopathic uterine bleeding, the incomplete abortions and ectopics are all most likely to have an associated secondary anemia of varying degree. Many such cases are dangerous operative risks, yet until recently it has been customary to operate upon such patients, often with an hemoglobin of 50 per cent. or less, and a marked loss of erythrocytes, with an inevitable higher mortality rate than is necessary, although a blood transfusion may be done after the operation as a last resort when the grave condition of the patient is realized. Indeed, I am under the impression that today such is the usual practice in many of our hospitals.

*Read during the Fourth Annual Congress of Anesthetists, the Associated Anesthetists of the United States & Canada in Joint Meeting with the International Anesthesia Research Society, The Breakers, Atlantic City, May 25-28, 1925.

Furthermore, our conception of the amount of blood lost in the course of an operation is in general very vague. This has been recently pointed out by Gatch and Little[1] of Indianapolis in a study they have made of this subject.

Loss Without Bad Effects.

Our idea as to the amount of blood a healthy individual can lose without marked inconvenience is based on our observation of blood donors. In our experience 500 c. c. to 750 c. c. is the average amount of blood that can be taken without symptoms, and that over that limit distressing signs begin to occur. The giving up of 500 c. c. of blood by an ordinarily robust individual certainly calls for no *heroism*, and our internes are frequently glad to earn some extra money in this way.

Laboratory experiments confirm these observations as it has been shown that animals can lose 25 per cent by volume without bad effects. Gatch's and Little's observations approximate our own experience in this regard. Their method of determining the blood lost at operation was based on colorimetric measurements of the blood recovered by washing the gauze sponges used. Their results showed that the method was accurate within 5 per cent.

A pan-hysterectomy for fibroids showed a loss of 304 c. c.; a radical breast amputation in a vascular case showed a loss of 710 c. c.; a nephectomy showed 816 c. c. It is easy to see that the loss of such amounts during operation in a patient with an hemoglobin of say 50 per cent. and with less than 3,000,000 red cells, may seriously endanger the patient's life. Especially is this true when we consider that such a patient's resistance may be still further lowered by the added shock to the sympathetic system of a severe or prolonged abdominal operation. Likewise in extensive vaginal plastic operations, there is nearly always a continuous capillary oozing of blood, which amounts to a considerable loss in an operation requiring an hour or more for its completion, and which owing to its insidiousness, is frequently not fully appreciated by the operator.

Our experience at the Woman's Hospital in a considerable number of cases shows us that 500 c. c. of blood as a prophylactic preparation for operation in cases of secondary anemia is sufficient in the majority of the patients to bring the blood condition up to safety limits. Occasionally a second, or even third transfusion may be necessary in very low blood states, but we find this unusual. Undoubtedly this is due to the stimulating effect on the blood making organs that a transfusion produces as evidenced by the progressive improvement in the blood state that continues for some time after the transfusion.

This fact is fortunate as it makes the obtaining of donors much less difficult, if not more than 500 c. c. are taken, and with a donor available there is no excuse for not bringing our patient to the operating room with her resistance at the best possible state in order to withstand the ordeal to be undergone with the maximum of safety.

All that is necessary then is the ability to perform the transfusion. Thanks to the work of Lewisohn anyone with the knowledge of the simple technic of an intravenous infusion can give a blood transfusion by the citrate method which is familiar to you all.

Use of Direct Method.

At the Woman's Hospital we use the direct method, as we believe its advantages make it well worth while, although formerly the citrate method was used. The technic we employ is that of Unger,[2] which has proved very satisfactory in our hands. Our internes are all trained in the technic, and in the past two years no interne has graduated from the hospital who is not an expert in giving a direct transfusion, and in typing and matching the donor and recipient's blood.

I have recently reviewed the blood transfusions done at the Woman's Hospital during the past two years by the direct method, and I have also had a study made of the reactions in this series by two Senior Cornell students (Souter and Duryea) during their course at the hospital, which will be shortly published.

In spite of the perfected technic and the more accurate methods of typing, post-transfusion reactions occur in about 25 per cent. of cases, but fortunately the danger of gross incompatibilities may be said to be eliminated, and the reactions observed are usually not of a severe type, and are not sufficient to counteract the great therapeutic advantage of the transfusion. Still we cannot feel that the technic of blood transfusion is perfected until we can eliminate reactions in all cases. The cause of these reactions is still obscure and we cannot foretell when a reaction will or will not occur. As yet the problem has only been solved in its grosser aspects. The experimental work of Guthrie, Huck, and Pessel[3] has shown that it is probably necessary to modify the accepted classifications of the blood types of Jansky and Moss as they have demonstrated five isoagglutinins and isoagglutinogens in human blood. It is probable that the skill and dexterity of the operator in making a speedy transference of blood is a factor of considerable importance.

Our method is to use the Moss classification and the hanging drop method in the typing, and in addition the donor and recipients bloods are directly matched in all cases for at least thirty minutes. We regard this last step as of the utmost importance in checking up on the compatibility. We also consider it very necessary that the donors' blood state be checked up at the time of the transfusion as it has occasionally happened that the donor has had an unsuspected secondary anemia. This is especially

so if a professional donor is being used, and will of course give a disappointing result. Many patients will be saved if every case is typed as a routine and a list of donors kept available for emergency use.

REACTIONS FROM LARGE AMOUNTS.

Our study seems to show that transfusions of more than 500 c. c. of blood were followed with a higher percentage of reactions than with the smaller amounts, and repeated transfusions increased the percentage of reactions. We do not find that a transfusion increases the blood pressure to any marked extent, and, therefore, do not hesitate to give a preoperative blood transfusion in cases of internal hemorrhage such as in ectopics, as we do not fear further bleeding from increased pressure. We have also observed that at the end of forty-eight hours the highest percentage of increase in hemoglobin and red cells occurred in those patients who had had reactions.

It is our practice in cases of profound operative shock to give immediately an intravenous infusion of 250 to 300 c. c. 6 per cent. gum acacia and 20 per cent. glucose solution at a rate of 4 c. c. per minute at a temperature of 105° F. as advocated by Farrar,[4] which will at once raise the blood pressure and hold it for several hours, thus combating the state of shock until the blood transfusion can be given. This we find is a safe and most valuable aid in an experience of many hundreds of such infusions.

We now have accurate records of 282 direct blood transfusions done on the gynecological service of the Woman's Hospital during the past twenty-six months, which record the temperature, blood pressure, pulse, and complete blood examination before, directly after, two hours after, and forty-eight hours after the transfusion, in addition to the general facts concerning donor and recipient. Prior to that time, the records did not give complete details, the methods were variable and the technic was not standardized, and the transfusion was in general use only as a resort in desperate cases. Of these 282 transfusions, more than 50 per cent. were preoperative prophylactic transfusions, done to bring the patient to the operation with her maximum of resistance, and in addition a considerable number were done at the time of the operation or immediately after as a prophylactic measure and not because of the precarious condition of the patient. And I wish to emphasize the point that in many of these cases, the patients were *not* in a state of marked secondary anemia but showed a moderate loss only, as for example 65 to 70 per cent. hemoglobin and 3,000,000 to 3,500,000 red cells. That this preparatory treatment was well worth while, is unquestionable, our mortality and morbidity being reduced and the beneficial results, as shown by a much speedier and smoother convalescence, are acknowledged by the entire staff. I feel sure that the adoption of *routine* preoperative blood transfusions in patients, whose resistance has been lowered, or whose blood examination shows a reduction under 75 per cent., will reduce the operative mortality rate of any hospital as it has ours, which last year was 1.6 per cent. for all cases.

One of the great benefits that has come out of the Hospital Standardization movement, which was first stimulated by Codman, is that today we give careful preoperative study to our patients. The light of the Staff Conference beats too strongly on our after-results to allow of the railroading of the patient to operation when no emergency exists. Thus with a better knowledge of our patient's condition we have no excuse for not giving her the advantage of this valuable prophylactice measure, should her resistance and blood state require it.

SUMMARY.

In conclusion I would emphasize the following:

1. That blood transfusion should be employed as a *routine* prophylactice measure before operation much more frequently than is the present practice, especially in gynecological cases.

2. That every interne on graduation from a hospital should be competent to make the necessary blood typing and blood matching technic, and to perform a blood transfusion, preferably by the direct method. The blood examination is often necessary at night or on holidays when the laboratory force is not available. This implies definite instruction and the skill which comes with practice.

3. That 500 c. c. of blood is sufficient in a large proportion of cases for a prophylactic transfusion, and thus this amount is not sufficient to cause the donor distress.

4. That the amount of blood lost in many gynecological operations is not always appreciated by the operator and is a factor that should be considered where patients have a lowered blood state.

5. That while post-transfusion reactions occur in about 25 per cent. of cases they are usually not of a serious type provided that the donor's and recipient's blood have been directly matched, and that they do not appear to mitigate the benefits of the transfusion.

6. That if this procedure is more generally adopted, it will result in an appreciable improvement in our mortality and morbidity statistics.

48 EAST 52ND ST.

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STUDIES IN ALPHA-LOBELIN RESUSCITATION.*

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and
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The alkaloid Alpha-Lobelin, which we are privileged to discuss before you, has the peculiar distinction, together with carbon dioxid, of being to date the only specific stimulant of the respiratory center we possess with no secondary actions of importance in physiological doses.

At this point it is necessary to distinguish between Alpha-Lobelin and the old Dreser Lobelin sulfate, etc. Alpha-Lobelin is the *pure alkaloid,* which was isolated in crystal form by Henry Wieland for the first time in 1918. The old Lobelin preparations are a crude mixture of various alkaloids of the plant and various resins and none of these were ever recovered pure before Wieland's work.

PHARMACOLOGICAL STUDIES

Wieland's brother Herman, who had suggested

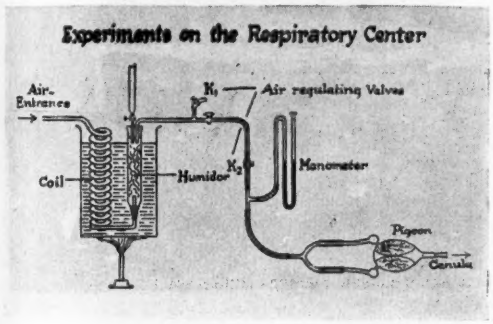


Fig. 1.

the purification of Lobelin, studied the drug pharmacologically. He noted the difference between the new drug and the older Lobelins. Alpha-Lobelin—despite doses which were 100 times the physiological dose—never induced vomiting, whereas, of the older Lobelins, Dreser remarked that in this respect they were in no wise less efficient than apomorphin.

[1]In his study of Alpha-Lobelin's action upon the respiratory center, Wieland utilized a unique technic. The fact that the alveoli of the birds' lungs do not end in a blind sac but pass out into the pneumatic bones makes it possible for the experimenter to pass air into the wing bone and so ventilate the body. This reduces the CO_2 tension of the blood below the threshold value and a condition of apnea results. With this method Wieland attempted to determine the threshold value of the blood CO_2, an increase above which leads to a stimulation of the respiratory center and hence respiration; a decrease of which leads to apnea. He discovered that this value for pigeons is about 2 per cent; that is under normal conditions, more than 2 per cent of CO_2 in the blood of pigeons leads to respiration, less than this to apnea. (Fig. 1).

When narcotized, the respiratory center requires a more powerful stimulation, that is narcotics and anesthetics *depress* the center.[2] In the case under question a urethan-morphin narcosis revealed a threshold value of 3.1 per cent. However, upon the application of Alpha-Lobelin this threshold value was immediately decreased from 3.1 to 1.2 per cent This can only mean that Alpha-Lobelin stimulated the respiratory center so powerfully that not only was the depression of the narcosis eliminated but the respiratory center reacted now to a CO_2 percentage which lay far below the normal threshold value. Alpha-Lobelin must ,therefore, be regarded as a specific stimulant of the respiratory center and a direct physiological antidote to narcotics and anesthetics.[3] A study of the effect of Alpha-Lobelin on the rabbit revealed an increase of 459% in respiratory volume. (Figs. 2 and 3).

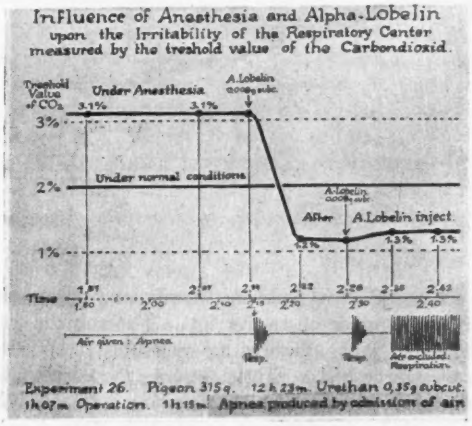


Fig. 2.

Wieland studied Alpha-Lobelin's action on other organ systems and summarized them as follows:—

1. Vomiting never occurred.
2. Vagus depression was absent; in fact a vagus stimulation was suggested.
3. Depression of the heart never occurred *in vivo* but only *in vitro* in enormous concentrations.
4. Blood pressure sometimes showed a very slight and transient depression.
5. The drug was destroyed in a short time, ¾ hour. No cumulative action followed when injections were repeated at intervals of 20 minutes.
6. Lethal dose never developed despite convulsions after 100 times the physiological dose.
7. Alpha-Lobelin was a physiological antidote to various respiratory poisons, such as morphin, chloral, etc.

*Read during the Fourth Annual Congress of Anesthetists, the Associated Anesthetists of the United States & Canada in Joint Meeting with the International Anesthesia Research Society, The Breakers, Atlantic City, May 25-28, 1925.

CLINICAL STUDIES.

Upon Wieland's suggestion the Childrens Clinic of the University of Freiburg took up the clinical study of Alpha-Lobelin. It was our privilege to take part in this work. Eckstein and Rominger, who published the results, were able to confirm the laboratory findings. Very remarkable action was noted in all cases of central respiratory depression from many different causes, such as respiratory collapse during operations, CO_2 intoxications due to pneumonia and stenoses and in cases of poisonings from morphin, chloral, etc. In cases of poisoning one may speak of Alpha-Lobelin as a true physiological antidote of respiratory poisons[4] as shown in a chart of the respiratory curve made by the physiologist Eckstein in a case of tuberculous menigitis, in which you will note the immediate improvement in the shallow and pathological type of respiration. The use of Alpha-Lobelin in cases of gas poisoning immediately suggests itself and in the study of these cases Behrens

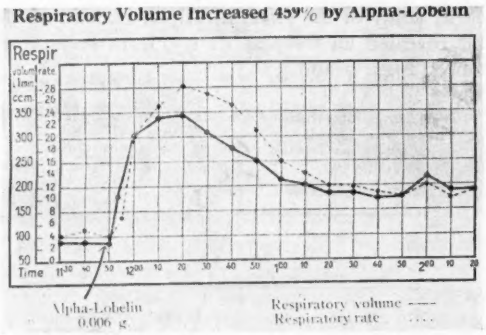


Fig. 3.

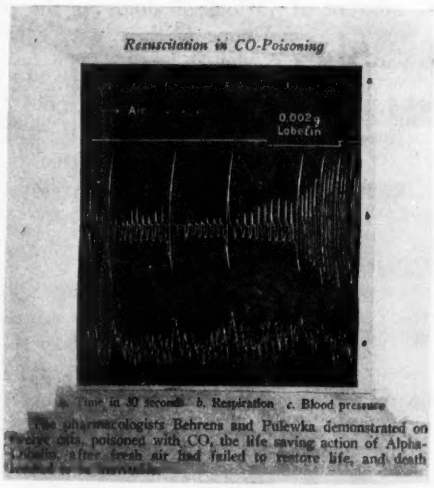
and Pulewka[5] have published some very interesting experiments made on twelve cats. The animals were asphyxiated with illuminating gas until respiration had almost ceased. Fresh air was then given for 2 minutes with no effect, whereupon Alpha-Lobelin was injected. In all cases respiration started again and reached normal values even in cases of apparently fatal poisoning. (Figs. 4 and 5).

An extensive clinical literature has developed about Alpha-Lobelin and about 30 reports have been published with records of over 300 case reports. The theoretical possibilities of the drug have been realized at the sick bed and on the operating table. I can only, however, mention the results of Miltner of Doederlein's clinic, who resuscitated 32 cases of asphyxia neonatorum. His eight failures proved in post mortem to have had pathological conditions which excluded the sustainance of life.

ALPHA-LOBELIN IN ANESTHESIA.

The clinical reports of Alpha-Lobelin used in conjunction with anesthesia will, however, prove of more interest to anesthetists.

In cases of respiratory collapse during anesthesia, Hoechstenbach, Hellwig of Frankfurt, Puppel of Budapest and Grill all report the same results. Cessation of respiration, cyanosis or death like pallor, weak pulse, mydriasis and often times areflexia. Artificial respiration and the various stimulants, such as camphor, were tried with no success. Within 1½ min. of the injection of Alpha-Lobelin the first spontaneous breath, which within five minutes became normal respiration, allowing resumption of operation. The report of Grill deserves perhaps particular consideration. We have here two cases of severe shock in miners who were seriously injured by falling stones and who had been subject to severe hemorrhages. All the mechanism of the modern operating room was at the disposal of Grill. Infusions, digipurat, adrenalin, camphor,—but all failed. The patients, as Grill remarks, seemed to stand before



The pharmacologists Behrens and Pulewka demonstrated on twelve cats, poisoned with CO_2 the life saving action of Alpha-Lobelin, after fresh air had failed to restore life, and death

Fig. 4.

an *exitus letalis*. Here again Alpha-Lobelin restored respiration, the already lost cough reflex became active, the pulse returned to a fair quality and the patients recovered.

In an article, which will be published shortly in the *Medical Journal and Record*, Dr. Hofmeister and I have described eight cases in which we noted the same results.

We can, therefore, conclude from personal experience, as well as from the study of the literature on the subject, that in Alpha-Lobelin we have a drug of a specific, powerful and reliable stimulation of the respiratory center. To date no evil results have been noted from the drug. In one case in the Children's Clinic of Freiburg an overstimulation of the center was noted after a large dose given intravenously. Wieland, in his first report, had warned against this. In general Alpha-Lobelin gives a very quick response—within 1 to 1½ minutes of injec-

tion. Cumulative action is impossible as the drug is very rapidly destroyed in the body; within ¾ of an hour at the most, so it seems to be possible in all cases to repeat the dose.

Method of Use and Dosage

Wieland recommended the subcutaneous use of Alpha-Lobelin, since this method approached most closely the ideal of a transfusion. However, in critical cases and especially when the circulation is very weak, the intravenous injection cannot be denied the patient. The intramuscular injection stands midway between the subcutaneous and intravenous as regards rapidity of response and duration of effect.

The doses that seem to date to have given the best results are:—for adults subcutaneously 10 mg., intravenously 3 mg, for children 3 mg; and 1 mg on repetition. I wish, however, to leave this question open; there is no doubt in my mind that the amount of the dose must vary with the degree of intoxication or depression of the center. For instance, Wieland discovered that larger doses were necessary for chloral and urethan poisoning than for morphin.

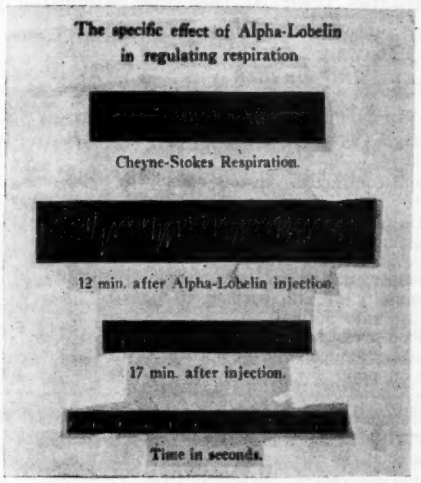

The specific effect of Alpha-Lobelin in regulating respiration
Cheyne-Stokes Respiration.
12 min. after Alpha-Lobelin injection.
17 min. after injection.
Time in seconds.

Fig. 5.

We may state, as a general rule, that Alpha-Lobelin is indicated in any case of central respiratory depression whether this be due to direct insult to the center through endo- or exotoxins or whether it has been depressed indirectly by the failure of the circulatory or peripheral respiratory system.

I do not wish to close without asking members of the Congress of Anesthetists to regard Alpha-Lobelin as a drug open to and well worth investigation. There are many problems to the solution of which the drug may be applied. Sattler, for instance, has used the drug post-operatively as a detoxicating agent in the sense of Gwathmey, with the hope of hyperventilating the body and removing the anesthetic agents quickly. The same thing was suggested recently by Henderson in the treatment of acute alcoholism. Could not Alpha-Lobelin do service here? Again there is the very interesting subject of the synergism of Alpha-Lobelin and CO_2 as would be found in the use of the drug and the Henderson-Haggard apparatus.

The last question which I shall ask is that of the effects of peroral administration. No work has been done on this subject yet. If Alpha-Lobelin could be given by mouth, its field of indication would be expanded and it is undoubted value in pneumonias or in the prophylaxis of pneumonia of the aged and bedridden might be utilized to the full.

57 Myrtle Ave.

THE ADMINISTRATION OF ETHYLENE-OXYGEN.*

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Current literature reveals practically all the data relative to ethylene anesthesia with the exception of its administration. It is assumed that those, who are familiar with the administration of nitrous oxid and oxygen, are also familiar with the use of ethylene and oxygen, which, is for the most part, true. My paper is intended principally for those who have had no previous experience with gas anesthesia, especially with ethylene anesthesia. The technic of administration described is applicable to cases of ordinary abdominal section, since an expert anesthetist would have little difficulty in applying it to other types of cases.

Indications and Precautions

Ethylene is indicated in nearly all types of ordinary minor surgical cases, especially if profound relaxation is not necessary. Its principal indication, however, is the weak, debilitated patient. There is, at present, probably no other anesthetic agent which affords as profound anesthesia with as little reaction as does ethylene for the weak patient and the poor risk that the advantages of ethylene are most strikingly demonstrated.

During the administration of an ethylene anesthetic, the conduct of the operating room must be the same as if it contained a small leak of illuminating gas. In operations requiring a cautery or similar apparatus, its use is contraindicated. Neither will it suffice, combined with oxygen, for laparotomy in the presence of acute peritonitis, and it frequently fails in operations on the gall-bladder. It does not afford the profound relaxation that can be obtained with ether.

*Read during a meeting of the Webster County Medical Society, Fort Dodge, Iowa, November 25, 1924. Courtesy of the Iowa State Medical Journal.

INDUCTION AND OPTIMAL SATURATION

In a case of ordinary gastroenterostomy, the patient is placed on the operating table; the ankles and wrists may or may not be fastened down. Any good gas machine that has been loaded with a supply of ethylene, oxygen and ether may be used. The face mask must fit snugly; therefore different sizes of masks are desirable. After opening the tanks, a stream of 80 per cent ethylene and 20 per cent oxygen from the mixing chamber is allowed to enter the bag until it is moderately inflated. The mask is slowly lowered until it fits snugly on the patient's face. It is only the first two or three breaths of ethylene that distress a sensitive patient. By the time the fourth or fifth breath has been taken, the sense of smell has been dulled and semi-consciousness produced. The patient may require rather a strong mixture and yet retain a good color, and so the percentage of oxygen in the mixture is reduced to 5 or 10 per cent in the induction period, which usually lasts from twenty-five to fifty seconds. The percentage of oxygen is slowly increased to percentages as high as 15, 20 or 25, depending on the extent of relaxation demanded and produced. From the second minute of the anesthetic, which is equivalent to the first minute of the second stage, saturation of the patient with ethylene begins, and continues gradually, if the mixture respired is not altered for a time in its percentage of ethylene and oxygen. The optimal saturation usually exists at the end of the first ten or fifteen minutes of the anesthesia. At this time, the patient being saturated with the gas, it is possible to reduce the strength of the mixture and still maintain anesthesia. Therefore, in order to obtain satisfactory results with ethylene in abdominal surgery, it is, as a rule, advisable to start the anesthetic at least ten minutes prior to the time when the peritoneum is to be incised.

SIGNS OF ANESTHESIA WITH ETHYLENE AND OXYGEN

A. WITHOUT MORPHIN

First stage (40 to 60 seconds) 90 per cent C_2H_4+10 per cent O_2.

1. Pupil normal, occasionally a sudden fleeting dilatation. Reacts quickly to light.
2. Skin pink.
3. Relaxation absent.
4. Eyeball moving freely.
5. Temperature of skin unchanged.
6. Humidity of skin unchanged.
7. Pulse rate often increased.
8. Blood-pressure often about 20 mm. high or low.
9. Respiration voluntarily normal.
10. Blood pink.

Second stage (light surgical anesthesia, occasionally a period of excitement) 2 to 5 minutes, 85 per cent C_2H_4+15 per cent O_2.

1. Pupil normal or slightly dilated. Reacts quickly to light.
2. Skin pink.
3. Relaxation moderate.
4. Eyeball moving.
5. Temperature of skin normal.
6. Skin dry.
7. Pulse rate usually normal.
8. Blood-pressure usually normal.
9. Respiration deeper and faster.
10. Blood red.

Third stage (deep surgical anesthesia) 5 to 15 minutes, 80 per cent C_2H_4+20 per cent O_2.

1. Pupil slightly dilated. Reacts to light. 2. Skin pink.
3. Relaxation good. 4. Eyeball fixed, often turned and fixed.
5. Skin warm. 6. Skin dry.
7. Pulse rate normal or slowed.
8. Blood-pressure normal or lowered.
9. Respiration normal as in sleep. 10. Blood pink.

B. WITH MORPHIN

First stage (25 to 50 seconds) 85 per cent C_2H_4+15 per cent O_2.

1. Pupil contracted. Reacts quickly to light.
2. Skin pink.
3. Relaxation slight or absent.
4. Eyeball moving freely.
5. Temperature of skin unchanged.
6. Humidity of skin unchanged.
7. Pulse rate normal.
8. Blood-pressure normal.
9. Respiration voluntarily normal.
10. Blood pink.

Second stage (light surgical anesthesia, usually no excitement) 2 to 3 minutes, 80 per cent C_2H_4+20 per cent O_2.

1. Pupil contracted. Reacts to light.
2. Skin pink.
3. Relaxation moderate.
4. Eyeball moving slowly.
5. Skin normal.
6. Skin dry.
7. Pulse rate slightly increased.
8. Blood-pressure normal or slightly lowered.
9. Respiration faster.
10. Blood red.

Third stage (deep surgical anesthesia) 3 to 10 minutes, 75 per cent C_2H_4+25 per cent O_2.

1. Pupil normal. Reacts slowly to light. 2. Skin pink.
3. Relaxation very good. 4. Eyeball fixed, may be turned and fixed.
5. Skin warm. 6. Skin dry.
7. Pulse rate normal or slowed.
8. Blood-pressure normal or lowered.
9. Respiration normal as in sleep. 10. Blood pink.

Fourth stage. Premortem (at any time) 97 per cent C_2H_4+3 per cent O_2.

1. Pupil dilated. Does not react to light. 2. Skin blue, black, and finally gray.
3. Relaxation complete. 4. Eyeball fixed. 5. Skin cold.
6. Skin moist. 7. Pulse rate fast, irregular and faint. 8. Blood-pressure very low.
9. Respiration shallow, irregular and inhibited. 10. Blood black.

Anesthesia During the Operative Period

Let us assume that the anesthesia has been started, and the induction period is passed, and that surgical anesthesia has been established and the skin incision made. It is necessary at this time to keep the patient as deeply anesthetized as possible, and still give from 15 to 20 per cent oxygen. Occasionally a patient will require as high as 90 per cent ethylene in this early period. It is ordinarily better not to decrease the oxygen below 10 per cent and if ether is not particularly contraindicated, to add a little of it to the ethylene-oxygen and raise the oxygen to 20 per cent. As the peritoneum is incised and the exploring hand passed through the abdomen, the patient may stop breathing. Cyanosis rapidly develops, and must be avoided by the administration of oxygen; however, this is given only until the patient has respired two or three times, or until the cyanosis disappears. Then the percentage employed in the latter part of the induction period is abruptly restored. With the conclusion of the exploration and the delivery of the diseased organ into the wound, anesthesia may be lightened; this amount is usually sufficient for the period of operating to within five minutes of closure. The deep anesthesia used during the incision and exploration must then be induced. After the peritoneum and posterior fascia have been closed, light anesthesia is used, as during the middle of the operation. The anesthesia may be discontinued just before, or during the time the last suture is being placed. It is the custom of some anesthetists to terminate the anesthetic with the administration of a considerable quantity of oxygen. It makes little difference how this anesthetic is terminated, so long as the final mixture is light.

Adjuvants

A good psychic effect may be obtained for temperamental patients by an induction with nitrous oxid, followed by ethylene and oxygen. For the majority of patients it is an application of the Golden Rule. Preoperative hypnotics given either in water or in magnesium sulphate solution are often indicated, especially for nervous patients and for very muscular patients. The best adjuvant is ether, however, and is easily administered with ethylene and oxygen; in combination with these agents it usually produces a satisfactory anesthesia. If the anesthetist is familiar with the four agents ethylene, oxygen, ether and morphin, these afford good results.

The second best adjuvant is local anesthesia, as it has the qualities which complement ethylene. Novocain in moderate amount and strength does not add shock or unpleasantness to the anesthetic.

Occasionally respiration becomes inhibited, regardless of the anesthetic agent used. For instance at the end of the induction period with ethylene and oxygen, a patient will occasionally hold his breath. One must be watchful and anticipate the cessation of breathing by the administration of a breath or two of oxygen which, of course, eliminates the embarrassment which otherwise results. Respiratory inhibition is more common, however, at the time when ethylene-oxygen anesthesia has become established, and an attempt is made to introduce ether with it. This is usually the result of sudden addition of ether, in concentrations above 7 per cent, or stronger than can be used during the induction period of an open ether anesthetic. Whenever ether is added, the exhaling valve should be opened, and the percentage of oxygen increased. When the ether is turned off, the exhaling valve is closed. This difficult situation is also faced during the administration of ether by the open drop method. That is, the patient sometimes holds his breath reflexly before anesthesia becomes established, and occasionally during the course of the anesthesia. In about a dozen anesthetics, I have been able to handle such a situation without difficulty by administering a little carbon dioxid with the ethylene and oxygen, or ethylene, oxygen and ether, as the case may be.

Patients with acute peritonitis do not relax satisfactorily with ethylene and oxygen alone, but relax well with ethylene, oxygen and ether, provided plenty of ether is used. Lesions of the gall-bladder cannot be routinely operated on under ethylene and oxygen, or even under ethylene, oxygen and ether anesthesia. In such cases the most uniformly satisfactory method is the open drop ether. The future, however, holds out a possibility that carbon dioxid will aid in overcoming the difficulties attending operation on the gall-bladder, inasmuch as it is assumed that while the carbon dioxid escorts the anesthetic, the patients will not be able to hold their breath long enough to grunt. Carbon dioxid makes general anesthesia easier and gas anesthesia more efficient, as respiration is more easily controlled.

Signs and Symptoms of Ethylene-Oxygen Anesthesia

The signs of anesthesia are outlined in the tabulation. These stages and signs of anesthesia are only approximate, because they are often fleeting and at first pass unnoticed. Postoperatively there is frequently momentary nausea, and pos-

*Since this paper was read this series has been increased to 400. The application of the nitrous oxid, ethylene, oxygen and carbon dioxid anesthetic, and ether if necessary, will probably be used extensively in the future

sibly the stomach will empty. The patient does not always vomit, but nausea may be annoying, when ether is added or when the gas is impure.

Prostration is noticeably absent, particularly if ether is not added to the ethylene and oxygen. Rebreathing and ether cause sweating, but this is easily controlled with atropin. A sudden return to consciousness may mean the quick onset of post-operative pain. Morphin affords the necessary relief.

TEAM WORK.*

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Although efforts to alleviate pain during surgical procedure were practiced from time immemorial, it was not until Morton demonstrated etherization, in 1846, that practical anesthesia became a reality. However vague and uncertain the efforts before that time, there is no doubt about the truly wonderful development of anesthesiology since Morton's previous work. Much further progress may be confidently predicted. The list of scientific investigators, chemists, inventors and physicians who have and are devoting their time and efforts to the development of better anesthesia is a long one. Along with progress in methods of eliminating or alleviating pain during surgical procedure has gone the marvelous development of modern surgery. Better anesthesia makes better surgery possible. The dangers attending surgery and anesthesia have been recognized and much has been done to overcome them, and work still goes on to lessen and avoid those that still seem unavoidable.

It should be a matter of congratulation that the necessity of education in anesthesiology has been recognized and that courses are now included in most of our medical curricula. Education in this branch of medicine is as necessary and important as in any other, and unless we can appreciate the co-relation of anesthesia with other branches of medicine, our work becomes purely mechanical. The anesthetist must be trained as well as the surgeon, and by the proper training and co-ordination of their efforts good team work may be achieved.

The Rôle of the Anesthetist

The anesthetist should be much more than simply the one who administers a certain chosen anesthetic. His knowledge of medicine should be such that he would be considered a consultant before, during and after the operation. He should be able to evaluate the physical signs and symptoms, the laboratory findings, etc., so as to form an accurate opinion as to the patient's ability to take an anesthetic and the anesthetic required. It is the anesthetist who watches the general condition of the patient throughout the operation, and by the intelligent estimation of the condition institutes such remedial measures as may be necessary.

That he must possess mechanical perfection in administration goes almost without saying, and in this connection we may well be grateful to those within our ranks who have devised mechanical means for the administration of anesthetics with certainty and precision, and these we should be familiar with, never forgetting, however, that a machine is still a machine and that the patient's condition is the final criterion as to whether the anesthetic is being delivered properly.

Mechanical prefection is not enough. We must co-ordinate the mechanical part of administration with the known pharmaco-physiological reactions of the anesthetic. All patients are not alike, and we must be able to vary our agents, sequences, mixtures, and amounts according to the individual requirement. Also we should be sufficiently conversant with surgical technic to be able to follow the operation and realize the reaction of certain procedures. We cannot always anticipate the next step, and a word from the surgeon is invariably an aid.

Our interest in the patient does not stop with the closing of the wound and the withdrawal of the anesthetic. Having watched the patient as to his condition throughout the operation, we should be able to advise as to post-operative measures, which may be necessary.

The Patient's Viewpoint

I wonder if we are always able to get the patient's viewpoint. We, working in and familiar with hospital atmosphere, may find it difficult to realize the impressions an individual may receive amid these unfamiliar surroundings, not always the most reassuring to the lay mind. Sometimes in our hurry we seem to forget the individuality of the patient and the various factors that may increase his nervous tension, and, all on edge, he is more or less hurried into unconsciousness amid strange sounds and conversation that are anything but soothing.

Do we not lose a great deal in attempts to hurry? During a crowded day, the temptation to do so is almost irresistible. Speed is a requisite in the successful carrying out of our work, and is only retarded by hurry. For instance, it does no good to hurry a patient to the operating room and then have him wait fifteen or twenty minutes

*Chairman's Address read during the Joint Meeting of the Section on Anesthesiology of the California State Medical Society with the Pacific Coast Association of Anesthetists, Yosemite Valley, May 18-20, 1925.

before the anesthetic is begun. It does no good to hurry the anesthetic, though the combination of a refractory patient and a rushed impatient surgeon will sometimes make one try it, always to one's regret. It takes about so long to obtain surgical anesthesia, and when we try to rush it we usually find we haven't saved time, but have overdosed the patient. The use of local anesthesia by modern technic and the use of nitrous oxid, either alone or in combination, have shown us the advantages of gentle and unhurried manipulations. We have found, too, that with the more potent anesthetics that a little patience and gentleness will let us obtain the necessary relaxation without unduly saturating the patient.

Preparatory, Operative and After Care

In all instances proper pre-operative preparation of the patient should be insisted upon. There should be a complete physical examination and urinalysis. Too often we guess the kidneys are normal. Blood examination and blood pressure give us valuable aid in estimating the patient's condition. The advisability of using a preliminary narcotic is still perhaps somewhat of a moot subject, though most of us use one, believing, that its advantages far outweigh its disadvantages.

It should be seen to that the patient is adequately protected from cold at all times, most especially during and after the operation. The position of the patient deserves more importance than it usually receives. Slight and simple adjustments can easily make it one of ease to the patient then and after, and by taking the muscles off the stretch, aid greatly in obtaining relaxation.

It should be seen that our anesthetic apparatus is in perfect order with an adequate supply of anesthetic, and that whatever may be needful is at our finger-tips. Also that the means of stimulation or resuscitation are ready for use at all times and may be applied with the least confusion and delay.

Much in the way of preparation, examination, and various procedures for the patient's safety and comfort seem most of the time to be rather small points, but if one of them is omitted at the wrong time the consequences may loom extraordinarily large.

Much benefit is to be gained by conference with the surgeon as to the progress of the case, noting the effect of the anesthetic after the operation as well as during it.

Conclusions

I have tried briefly to indicate various points whereby the anesthetist may co-ordinate his efforts with those of the surgeon, to the end that the patient may more certainly recover. By education, training, and a broader conception of anesthesia we become as skillful in our specialty as the surgeon is in his. Our knowledge of the subject must be that of a physician. It must be recognized that there is a close relationship between anesthesia and surgical procedure. Surgery is a therapeutic measure, done not for the sake of doing an operation, but in the interest of the patient's health. We work with the surgeon, sharing the responsibilities and co-operating with him, to the end that his success in getting the patient well may be assured. Our attempt is to render a service to both patient and surgeon in administering an anesthetic as skillfully and safely as our present knowledge and equipment will permit, co-ordinating our efforts with his toward the recovery of the patient.

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ETHYLENE ANESTHESIA: WITH OBSERVATIONS ON 120 ADMINISTRATIONS

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Ethylene or olefiant gas is an unsaturated hydrocarbon having the formula C_2H_4. The narcotic action of the gas is said to have been discovered by Simpson and investigated by Nunnelly, of Leeds, but it is doubtful whether these early workers ever anesthetized patients with it. The recent observation that ethylene dissolved in pure ether alters its anesthetic properties revived interest in the gas, and its actions have been thoroughly worked out by Luckhardt, Carter and Easson Brown in America.

Preparation

Until recently it has been impossible to obtain pure commercial ethylene in Great Britain, and most of the gas used in the following cases has been kindly prepared by Dr. W. H. Hurtley, lecturer in chemistry to St. Bartholomew's Hospital. The method of preparation is known as Newth's process, and is briefly as follows: Syrupy phosphoric acid is heated in a round-bottomed flask to drive off water. A thermometer is placed with its bulb in the liquid, and boiling occurs at about 160°C. The heating is continued until the temperature rises to 200°C. At this stage the flask is fitted with a cork carrying (1) the thermometer, (2) a tap-funnel whose stem reaches below the surface of the liquid, and (3) a delivery tube connected to a wash-bottle standing in ice. Ethyl alcohol is then allowed to drop slowly on to the acid from the tap-funnel, the temperature of the mixture is kept at about 220°C. and the

ethylene collected over water. This method can be used commercially, and would be comparatively inexpensive, provided that duty-free spirit could be employed. The gas so prepared was compressed at a relatively low pressure (100 lb. per square inch) into ordinary nitrous oxid cylinders by means of an adapted motor-tyre pump. The remainder of the gas was imported from America to ascertain whether there was any appreciable difference in quality. It was found that the smell of the imported ethylene was pungent and resembled that of acetylene, while the other gas had a rather pleasant ethereal odor. At the same time there appeared to be no appreciable difference in the effects of the gases on patients, and the American ethylene when examined was shown to have a purity exceeding 99 per cent.

Properties

The odor of ethylene has already been mentioned and will be referred to again later. The main point of interest to the anesthetist is the inflammability and explosibility of the gas. Pure ethylene burns with a semi-luminous flame in the same way as hydrogen. A mixture of between 4 per cent. and 15 per cent. ethylene in air explodes with moderate violence in the presence of an electric spark. Mixtures of oxygen and ethylene explode with extreme violence if the oxygen percentage exceeds 40. It should also be observed that in this respect nitrous oxid acts in a similar manner to oxygen, a point to be borne in mind if anesthesia is induced with nitrous oxid and continued with ethylene. From these considerations it will be seen that the only likelihood of danger from explosion in practical work lies in (1) the application of any type of cautery to the region of the face or mouth if the patient is anesthetised with ethylene or mixtures of this gas with nitrous oxid or oxygen; (2) in cases where a double-airway endotracheal ethylene-oxygen anethesia is being given and the blast of the return airway is directed towards a naked flame, such as that of a steriliser; (3) in passing a tracheal catheter by means of a direct-vision laryngoscope with distal illumination. An imperfect contact or short circuit of the lamp might cause a minute spark, and for this reason the writer has now ceased inducing anesthesia with ethylene-oxygen if a tracheal catheter is to be passed.

The question of spontaneous explosion must now be considered. Ethylene being an endothermic gas, it was thought possible that under high pressure explosion might occur in a similar way to acetylene. This fear, however, appears to be groundless, as in America thousands of cylinders of ethylene have been compressed to about 60 atmospheres and explosions are unknown. At this pressure, however, ethylene behaves in a curious way. The critical temperature of the gas is given by various authorities as between 10°C. and 13°C. In spite of this, ethylene compressed to 870 lb. per square inch at 18°C. does not behave as a gas, but follows no definite laws of pressure and volume, being apparently in some border-line condition between the gaseous and liquid states.

From these observations it will be seen that if ordinary care is used ethylene is safe, but it should be remembered that were an explosion to occur the consequences would be very different from those following the alarming, but comparatively harmless "ether flare," but will probably involve the death of the patient and serious injuries to the anesthetist and other occupants of the theatre. One such explosion involving the death of three persons, has recently occured in America.

Physiological Action

Ethylene has an extremely powerful action on certain plants. For example, it was noted 15 years ago by Crocker and Knight that ethylene, in a concentration of 1 to 2,000,000 parts of air, caused open carnations to close. Upon animals and man a concentration of over 75 per cent. acts as an analgesic and anesthetic. Spectroscopic examination of the blood drawn from patients under ethylene anesthesia does not reveal any absorption bands, showing that the gas does not combine with the hemoglobin, but is probably in a state of physical solution in the plasma. On discontinuing the administration the gas is very quickly eliminated, although traces can be detected in the breath for several hours.

The systolic and diastolic blood pressures and the pulse-rate appear to be practically unaffected by ethylene, provided that enough oxygen is given to avoid cyanosis. If this is allowed to develop, the pressures naturally rise. The depth and rate of respiration are also unaltered, provided that means are taken to avoid accumulation of carbon dioxid. Muscular relaxation is a variable factor. All minor operations, except possibly the reduction of dislocations, can be performed under ethylene-oxygen alone, but most abdominal sections require the addition of ether or chloroform. There is no chemical action between these compounds, and the necessary amount of vapor can be added in the anesthetic bottle of a sight-feed gas and oxygen machine.

To sum up, the general picture of a patient under ethylene-oxygen anesthesia resembles one of natural sleep with a pink color, normal pulse-

rate and blood pressure, and with shallow regular breathing. The corneal reflex being present.

ADMINISTRATION

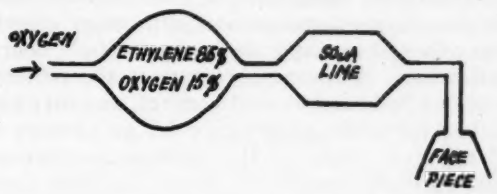
Ethylene has been administered in a variety of ways as follows:—

1. *Ethylene and Air,* given with the usual simple gas apparatus. This method is quite satisfactory for short minor operations, such as dental extractions, the opening of abscesses, and the like. In dental cases the nasal method can be employed for the prolongation of anesthesia in exactly the same way as with nitrous oxid.

2. *Ethylene-Oxygen with Partial Rebreathing.* The writer has employed an ordinary Boyle's sight-feed gas and oxygen machine for this purpose and finds it quite satisfactory. It is wise, however, to check the enthusiasm of the nurse who lights the spirit-lamp on the older patterns of the machine to warm the reducing valves. The great feature of this method is that the majority of patients can be kept anesthetised indefinitely on a mixture of 80-85 per cent. ethylene and 15-20 per cent. oxygen with no added ether. The result is a patient lying quite still with a pink color. Most anesthetists will agree that this is impossible with a pure gas-oxygen. Relaxation varies, but for abdominal cases some added ether is nearly always necessary.

3. *Ethylene-Oxygen with Carbon Dioxid Absorption and Complete Rebreathing.* Since ethylene is exhaled from the lungs unchanged, it follows that the same gas can be used again. The diagram illustrates the principle of the method. The two-gallon gasbag contains the ethylene-oxygen mixture, and "to-and-fro" breathing takes place through a metal chamber containing granulated soda-lime to absorb the carbon dioxid. Sufficient oxygen is added to keep the color pink. In practice a certain amount of leakage occurs and more ethylene must be added at intervals, but even so the method is extremely economical, as only about five gallons of gas are used in half an hour. The soda-lime must be changed when caked, but this does not occur till after four hours' use with a normal-sized filter. The most convenient apparatus to use is a Boyle's machine with the filter interposed between the bag and the face-piece, the stopcock being in the "no valves" position.

4. *Endotracheal Ethylene-Oxygen.*—The writer has induced anesthesia on several patients with ethylene-oxygen and then passed a tracheal catheter, continuing with endotracheal ethylene-oxygen. As previously mentioned, although sufficient relaxation can be obtained to pass the catheter easily, the chance of explosion seems to render the method somewhat risky. Anesthesia can be maintained with pure ethylene-oxygen, provided that the oxygen percentage is not allowed to rise too high, but for abdominal work or in other cases where great relaxation is required, some ether must be added.



RESULTS

The results obtained in the first 120 administrations of ethylene will now be summarised. The operations included abdominal exploration, amputation of the breast, excision of cysts, glands, ganglia and polypi, incision and drainage of abscesses, suture of tendons, circumcision, tonsillectomy, and dental extractions. The total time of anesthesia varied between two and 58 minutes, while the age of the patients was from 2 to 62 years.

The average time for the induction of anesthesia was 1 minute 50 seconds. No case gave rise to any anxiety during operation. Anesthesia was completely satisfactory in 110 cases with ethylene or ethylene-oxygen only. In five of the remaining patients a little ether had to be added to secure the necessary relaxation. The rest of the unsatisfactory cases were all dental extractions which exceeded the estimated time, a nasal apparatus not being available. If this could have been used there is no reason to suppose that the anesthesia could not have been extended to enable all the extractions to be completed. The "single-dose" method usually gives about 1¼ minutes anesthesia, which is longer than with a "straight gas" and rather shorter than with closed ethyl chlorid.

AFTER-EFFECTS

The noticeable lack of after-effects constitutes the chief advantage of ethylene anesthesia. Out of 120 cases, only ten vomited at all and two of these had some additional ether. Most patients exhibit some aphasia for a few minutes after coming round, but if the time of anesthesia has not exceeded ten minutes, they can usually walk without assistance three minutes after the face-piece has been removed. All the adult patients were questioned as to the smell, but only two complained at all strongly, the vast majority thinking that they had had nitrous oxid. From

personal observation, the odor is distinctly perceptible for the first few breaths, but then becomes unnoticable, as unconsciousness rapidly supervenes. The odor in the theatre is unusual, but is never strong enough to become a nuisance.

Patients are remarkably fit after ethylene anesthesia. A good comparison with ethyl chlorid was afforded by children having multiple dental extractions. Seventy per cent. of the patients who had had ethyl chlorid vomited, and they had to be kept under observation for an average of 35 minutes. None of the children anesthetised with ethylene vomited (59 cases), and they could be sent home after an average of ten minutes.

Conclusions

These results agree substantially with the reports of large numbers of cases anesthetised with ethylene in America, and appear to show that this gas has certain advantages over the other anesthetics at present in use, especially for minor operations taking a moderate time and which require more than nitrous oxid.

The writer understands that limited quantities of ethylene are now available from Messrs. Coxeter, Pancras road, N.W. 1. He wishes to express his thanks to Dr. W. H. Hurtley for the preparation of the gas and to Mr. Geoffrey Carte, Mr. T. P. Dunhill, and Mr. S. A. Withers for permission to anesthetise their cases with ethylene. The majority of the cases cited were anesthetised at St. Bartholomew's Hospital and the Queen's Hospital for Children.

34 Park Village East, Regeu's Park

EXTREME RESPIRATORY PARALYSIS FOLLOWING CAUDAL ANESTHESIA

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Caudal anesthesia is one of the safest and most established procedures of regional anesthesia, and until recently no serious accidents have been recorded following its administration. Zwiefel[1], in reporting 4200 cases notes 10 fatalities. In but 3 of these, when death followed within ten minutes after the injection, does he hold the anesthesia responsible. The cause of death is reported as acute procain poisoning. In a series of 600 cases coming under our direct or immediate attention[2,3,4] we have not seen death precipitated by caudal anesthesia. We have however, seen mild transient reactions and just recently a most severe case of respiratory paralysis which persisted for two hours and forty minutes.

Illustrative Case Report

It is reported in detail as follows:

Mrs. D., primipara aged 34 years, entered the hospital in labor and received the usual ether-oil anesthesia[5]. No further progress was made until the following day when labor really began. At 10:30 A. M. there was complete dilatation of the cervix and the perineum bulged with the head presenting just within the vaginal outlet.

Caudal anesthesia was induced at 10:35 A. M. Using a medium sized nickeloid needle (3 inches long), entry into the sacral canal was easily affected. Over one inch of the shaft was showing outside the sacral hiatus. Neither blood or spinal fluid were obtained upon aspiration when the needle was withdrawn slightly and rotated. With but one and one-half inches of the shaft of the needle within the sacral canal 40 c.c. of a freshly prepared 2 per cent novocain solution was slowly injected. Aspiration was attempted prior to the injection of every 10 c.c. of solution. The results were negative.

The patient was instructed to report any headaches, optical distress or sensation of nausea. She felt fine and appreciated the relief from her pains.

Five minutes after the injection the patient reported tingling sensations in her legs. Her perineal anesthesia was soon complete, and upon experiencing three good uterine contractions without pain, the patient worked well with each expulsive attempt. The membranes bulged, ruptured and the head was beyond the perineum partially delivered when the patient suddenly complained that she could not breathe. Her respirations first were short and labored then becoming fewer and irregular, finally ceased entirely. This was exactly at 11:00, 25 minutes after the injection had been completed.

Remedial Measures

As soon as the patient complained, she was raised to an erect position but she continued to grow worse artificial respiration was immediately started and inhalations of 100 per cent oxygen given.

Pituitrin, M. V., had been given at 11:00 but had had no effect. At 11:10 caffein sodium benzoate, grs. 7½, as given intramuscularly. The patient showed no signs of recovery. The slow oscillation of the eyes soon stopped and the pupils began to dilate. The artificial respiration with oxygen was being maintained but the heart gradually became slower. The rate, 90 at the apex, taken with a stethescope, dropped to an irregular, intermittent beat and suddenly paused for a seemingly prolonged period. Perhaps a few seconds elapsed without a sound. We immediately injected directly into the heart[6], after blood had been withdrawn into the syringe, 2 c.c. of 1:1000 adrenalin chlorid and increased the depth and frequency of the artificial

respirations. Time 11:15. The heart began beating. The bounding pulse ran up to 180 or over. The systolic blood pressure rose to 100 and the patient's color returned. There were no signs of returning consciousness.

As respiration did not become spontaneous it was maintained with oxygen and very close observation made of the heart rate, each succeeding minute.

The infant's head was slipped over the perineum, using low forceps application, and the delivery was complete at 11:30. The infant was pink and breathed very promptly causing no trouble whatsoever. The mother's heart began to slow down following the delivery but was maintained by giving 2 c.c. of caffein sodium benzoate intravenously. A tight abdominal binder was applied. Still no signs of returning consciousness though the intravenous caffein had brought back the oscillation of the eyes.

All effort was concentrated on maintaining the heart rate which was not permitted to fall below 70 per minute. Repeated intravenous injections of caffein[7] never failed to bring it up and maintain the rate over a period of 20 minutes or so. Digitalen, 1 c.c., and pituitrin, 1 c.c., finally held the rate steady for longer periods. We did not deem it safe to give any massive intravenous injections with the embarrassed circulatory condition. At intervals when the heart seemed good the oxygen was discontinued. Respiration did not start up and as the heart would become slower oxygen was readministered. No carbon dioxid was available to use as a respiratory stimulant. Finally at 1:40 slight diaphragmatic motion was observed, and with a little further assistance respiration was fully established at 1:45 P. M. exactly 2 hours and 45 minutes after it had ceased.

The patient returned to consciousness and was placed in a slight Fowler's position, the thorax kept warm with hot water bottles and digitalization begun. However no pneumonia set in and with but a slight post partum rise in temperature to 99.6° the patient experienced an uneventful recovery.

A Similar Experience

A similar experience is reported in brief[8]:—

A man, aged 50 to 60 years, received caudal anesthesia before a meeting of surgeons prior to a urological operation, 45 c.c. of 2 per cent novocain being used. Respiratory failure was almost immediate and after two hours of heroic measures this patient also recovered. It was generally conceded that in this instance the dura mater was punctured and that an overwhelming intraspinal injection had been given.

In the first case reported, however, since 20 or 25 minutes had elapsed before any respiratory embarrassment was noted we believe that the acute novocain poisoning was dependent upon delayed venous absorption.

This might occur as Thompson[9] suggests in his "Studies on Sacral Anesthesia." *"In the demonstration body it was noticed that while the injection was being made the eosin solution flowed out from external iliac veins."* In our detailed report it is possible that after the completed injection that the increased pressure during the strain of the expulsive efforts forced a sufficient amount of novocain into the systemic venous system either through the plexus filling the sacral canal or through an injured vertebral vein.

Conclusions

1. Some toxic reactions may follow caudal anesthesia either immediately or delayed, judging from our knowledge of two such reactions in a series of 600 cases.

2. Acute novocain poisoning may follow the puncture of the dura mater and the intraspinal injection of the solution or the absorption of the novocain into the systemic venous system, through the puncture of a large vertebral vein, and thence into the external iliac veins.

3. In spite of these possible dangers we believe that caudal anesthesia is relatively a most valuable form of regional technic and is a suitable and satisfactory procedure in various surgical, gynecological and obstetrical procedures[10 11].

4. The procedure can be made more safe by the addition of a prophylactic dose of caffein sodium benzoate into the solution injected as is done in intraspinal anesthesia.[12]

1620 York St.

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OCTOBER EDITORIALS 1925

DOGS AND PATIENTS AGAIN—AND CHIROPODISTS.

In a previous editorial the EDITOR of the ANESTHESIA SUPPLEMENT deplored the tendency on the part of teachers of the basic sciences in the medical schools to provide exceptional anesthesia for experimental animals without carrying over the same advances and protection to the operating rooms for the benefit of clinical patients.

It now appears as if the veternarians and chiropodists were providing a type of service for animals and patrons of a higher caliber than the average members of the medical profession—at least they are giving concrete evidence of an attempt to do this.

Recently the EDITOR's pet dog required an operation for a fibroid tumor and a rectal fistula. When the veternarian found out on questioning that the dog was over 9 years old, he said—"We will not use ether anesthesia on account of the dangers of cardiac collapse and postoperative pneumonia, and we will do the operations under local anesthesia." The operations were so done with every evidence of a high order of technical skill in the use of local anesthesia and with both comfort and safety to the dog, who made an uneventful recovery.

An age of 9 years in the dog corresponds to about the fiftieth year in the human being and in the same city in which the EDITOR's dog was operated under local anesthesia, there is no hesitancy in giving elderly patients ether saturations irrespective of the patient's condition or the operative or postoperative complications and dangers involved. A great many such etherizations are camouflaged as "gas anesthetics" because nitrous oxid is used for induction or as a vehicle for etherization. The after-effects are usually those of a very poor grade of ether anesthesia and in the elderly and poor risks usually determine disaster of one sort or another. It is certainly surprising that dogs should receive the benefits of *selective anesthesia* not accorded patients.

Anesthesia, general or local, is all but a lost art in the routine office, home and dispensary work of the average doctor and yet the Advertising Manager of one of the largest pharmaceutical houses recently told the EDITOR of a request from a convention of chiropodists for two medical experts to discuss the research and clinical phases of local anesthesia in reference to the work of chiropody. From this it would seem that the chiropodists have learned the lesson that the public enjoys, appreciates and pays for "painless" surgery, even of such a minor character as that connected with the treatment of corns, bunions and ingrown toe nails. Such "painless" treatment means patronage and dollars and cents to the chiropodists. When will the doctors learn this same lesson?

What are the medical schools and teaching hospitals going to do about the ignorance and inexperience shown by their students and interns about anesthesia and carried with them into private practice? How many of them are even capable of giving safe and comfortable pain relief in ordinary childbirth? Will minor surgery continue to be painfully agonizing when the great beneficence of "painless" surgery is within the grasp of any doctor in the profession?—McM.

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